ἄριστον μέν ὕδωρ

URBAN PLANNING AND WATER IN AKRAGAS AND METAPONTO

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URBAN PLANNING AND WATER IN AKRAGAS AND METAPONTO

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[1] Pindar, *Olympian 1*, sourced from the Perseus Digital Library, ed. Gregory Crane (Online: Tufts University, updated 2019).

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Abstract

This thesis examines the water resource management in two Greek colonies in Magna Graecia, Akragas and Metaponto, and the relationship between resource management and political regimes. It asks how similar ancient urban theory was to the practical reality, and if different forms of government made different provisions for water management.

Chapter 1 outlines urban and health theories found in the works of ancient theorists. It debunks the idea that Hippodamos was the inventor of grid planning, while introducing the concept of 'total' city planning. The focus of Classical scholarship on Athens necessitates discussions of several Athenian water systems and how resource management changed (or continued) through different governments in Athens as a point of comparison for Akragas and Metaponto. This chapter focuses on literary analysis and introduces the controversial Southeast Fountain House, with an in-depth consideration of the fountain's naming and dating problems.

Chapter 2 contains the case studies of Akragas and Metaponto and an exploration of the hydrogeology at the two sites, with an introduction to the hydrological phenomenon of karst activity. A discussion of their unique water features—the *kolymbethra* at Akragas and the canals in the *chora* of Metaponto—connects the deliberate planning that occurred in both cities to Hippodamos and the urban theorists.

Chapter 3 more fully explores the role of tyrants and democracies in water management. Regardless of authorship, water resource management and water systems are necessary for any city, and so most tyrannical water infrastructure continued to be used and expanded and improved upon even under different governments. Even under tyranny water management is a provision of the state and is engaged with and managed by the citizens of the city. Water management is an essential part of siting and establishing a city, so that it is inseparable from urban planning.

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Chapter 1
Water Management and Greek Theories of Urbanism

This thesis examines two sites in Magna Graecia with extensive water systems handled in different ways and compares them to the systems in place in Athens. Although often overshadowed by Roman achievements in manipulating the water supply, there is significant archaeological evidence for water management within the Greek city. There has been much investigation into the widespread and complex water management in the Roman Empire, but the Greeks were no less adept. There is evidence of incredible water manipulation even back to the Minoan period (ca. 3500-1100 BCE), with extensive pressure drainage and water delivery systems at Knossos and other palaces. This only continued and improved into the Hellenistic period—a time of rapid innovation in sanitation—when anatomical "flushing" toilets became widespread.[2] Remains of aqueducts, cisterns, wells, drains, and even artificial pools can be found in the archaic and classical city. In the archaic period, tyrants saw the necessity of providing a reliable supply of water—public consideration of effective water systems did not begin with Roman aqueducts, despite the Roman reputation for waterworks.

However, unlike the Romans, there is no great authority on urbanization and engineering, no Vitruvius and certainly no expert on water management like Frontinus. Although no earlier work can rival Frontinus' *De Aqueducta*, theoretical approaches to water management and the role of the water supply in Greek urbanism are discussed by a selection of authors including Hippokrates, Plato, and Aristotle. Taken together with Vitruvius' *De Architectura*, these works show that authors in antiquity were considering theoretical approaches to resource management,

[2] Anatomical "flushing" toilets did not become widespread until the Hellenistic period; though they were in use in the classical period, they were far from common. From Stavros Yannopoulos et al., "Review Paper: History of Sanitation and Hygiene Technologies in the Hellenic World", in *Journal of Water, Sanitation, and Hygiene for Development*. (London: IWA Publishing, 2017): 177.

theories that can be compared to extant archaeological remains. There are extensive ruins of ancient aqueducts, cisterns, and pipes which show widespread systems of sanitation and public water supply.

Every human settlement in history has had a preoccupation with water and the Greek city-states were no exception. Where to find water, how to collect it and store it, how to drain it, and how to control it, driving urban development. As a collective, the Greeks relied on water not just for agricultural and domestic uses, but also as a vehicle for trade and the importation of necessary goods (such as the wheat needed to feed the classical population of Athens), and for colonization and expansion. Specific waters were considered more sacred or more healthful than others and were used in purifications at temples or as medicines. The story of Greek colonization can be told through the development of water resource management: water supply, drainage, and waste removal are necessary for urbanization and dense settlements.[3] In the ancient Mediterranean, water management involved both the removal and reservation of water. Because access to, and the drainage of, water is so important to the development of a city, it is not surprising that theories about urban planning can be found in many extant texts, particularly after the 5th century BCE.

In Greek cities, the ways of controlling and using water were more localized to account for differences in the hydrogeology, as opposed to the more standardized systems of the Roman Empire, which imposed tried and tested water systems on vastly different climates through innovative engineering. Having noted this localization, the sites examined in this thesis all have a similar hydrogeology and the citizen body approached their water resource management in

[3] Dora Crouch, *Water Management in Ancient Greek Cities* (USA: Oxford University Press, 1993): 19.

similar ways. Metaponto is emphasized in this thesis due to the rich amount of archeological evidence for widespread irrigation and drainage in the countryside surrounding the ancient city.[4]

This chapter focuses on Greek writers on the built environment and the role of water management in the city, with a discussion of the waterways in Athens during the late archaic and early classical periods. In their works, Homer and Hesiod both discussed fantastic spaces and cities with improbable resources; Plato was concerned with the organization and maintenance of the ideal city, as was Aristotle, and special attention will be paid to the latter's discussion of Hippodamos of Miletos. Hippokrates studied the salubrious qualities of sources of water, and Vitruvius examined the engineering of water resources in cities, while Frontinus discussed the various good and bad waters around Rome and water resource management. The idea that environmental factors have an effect on citizens' bodies and characters is present in all these writers' works and finds its roots in the Pre-Socratic philosophers. Additionally, historians and playwrights offer glimpses of the use of fountain houses and daily interaction with public spaces and communal resources.

When discussing ancient theories of water systems, it is impossible to ignore the great impact the legacy of Roman water management and engineering has had on the study of water in the ancient world. The loudest voices on Roman considerations of water are Vitruvius and Frontinus. Though they are far from the only voices, it is for good reason that Vitruvius and Frontinus loom large, so I will make a brief mention of their thoughts on urban planning and on water here.

[4] I have spent some time on an archaeological project near Metaponto and so have had ample opportunity to observe the city and its countryside, as well as having access to the extensive scholarship on the area kept in the library of the Metaponto Archaeological Project. There is evidence of drainage channels and irrigation work around the city of Athens—the Great Drain collected rainwater and human waste and went through conduit pipes to a collection basin outside the town. There it ran out into the Kiphissos valley to irrigate and fertilize the fields (Yannopoulos et al, 2017: 168). However, this drainage system was not as systematic as the division and canal lines in the *chora* of Metaponto and so are outside the scope of this investigation.

Vitruvius outlines the ideal conditions for the siting of a city, just like many of the Greek theorists. Vitruvius focuses more on the effects of winds, fogs, and mists on cities, and—contrary to Aristotle's and Hippokrates' treatments on wind—prefers stagnant wind for good health. However, his discussion of the different winds is analogous to Hippokrates' discussion of the different kinds of water, and he does have an entire section dedicated to water in Book 8 of *De Architectura*.[5] He disparages the siting of a city in marshy areas due to the combination of fogs and mists which create unpleasant air, especially when infused with animal breath and stench and heated by the light of the sun.[6] This advice has unfortunate implications for Athens and Metaponto, which were both built upon marshy land that had to be navigated and drained, and even Akragas must have had marshy areas with such an abundance of water sources in the area.

Michael Lewis argues that when Vitruvius examines aqueducts in Book 8, he is primarily discussing Hellenistic aqueducts and not solely Roman projects, and that, in fact, Vitruvius is working off an Hellenistic Greek source from Pergamon. He points to the inclusion of particularly Greek tools, like *chorobates;* terms conceivably derived from the Greek, like *colliviaria*; and his conspicuous lack of a discussion of aqueduct arcades and open-water channels.[7] The lack of reference to Roman aqueduct staples like arcades and open channels

[5] Vitruvius, *De Architectura,* Book 8. Alessandro Nova, "The Role of the Winds in Architectural Theory from Vitruvius to Scamozzi," in *Aeolian Winds and the Spirit in Renaissance Architecture*, ed. Barbara Kendra (London: 2006): 72.

[6] Vitr.1.4.1: In ipsis vero moenibus ea erunt principia. Primum electio loci saluberrimi. Is autem erit excelsus et non nebulosus, non pruinosus regionesque caeli spectans neque aestuosas neque frigidas sed temperatas, deinde si vitabitur palustris vicinitas. Cum enim aurae matutinae cum sole oriente ad oppidum prevenient et his orate nebulae adiungentur spiritusque bestiarum palustrium venenatos cum nebula mixtos in habitatorum corpora flatu spargent, efficient locum pestilentem. Latin sourced from the Tufts University Perseus Digital Library, ed. Gregory Crane (Online: Tufts University, updated 2019).

[7] Michael Lewis, "Vitruvius and Greek Aqueducts," in *Papers of the British School at Rome,* vol. 67 (Rome: British School at Rome, 1999): 145; 164-167; 171. Lewis lays out convincing evidence for his argument, though he has no firm position on who Vitruvius could be copying in this section, and no extant evidence of an earlier work survives. However, Lewis ends his paper with a caustic remark on Vitruvius' age with the judgement that "Book VIII is a sloppy compilation of borrowings, largely from Greek writers, and shows little originality, clear-mindedness or intelligence on Vitruvius's part," (172) which seems an unfair criticism to level at such a complex and influential

instead of pipes is perhaps the most convincing part of his argument. That Vitruvius instead discusses closed pipelines relaying the water for aqueducts in conjunction with Greek tools and steep pipeline gradients, shows his familiarity with particularly Greek water systems. If this argument is true, then one of the greatest voices on Roman waterworks actually shows the good reputation and even influence Greek water innovations had on the Roman world. The role of Greece in the history of water manipulation and sanitation is often overlooked, particularly in the mainstream perceptions of Ancient Greece and Rome.[8]

Early in its history, Rome made use of wells, the Tiber, and springs—often sacred—before sufficient aqueducts were constructed. As public need for, and use of, abundant clean water grew with the population, more aqueducts and channels were built to provide the city with reliable access. Frontinus, water commissioner for the city of Rome in the 1st century CE, is inarguably the most important source on the management of ancient water systems. The clear and comprehensive treatise he wrote on the aqueducts of Rome is only disappointing on two fronts. Frontinus focuses more on the management and administration of Roman water systems than on their engineering. He also does not acknowledge the accomplishments of the Greeks. He goes so far as to unfavourably compare the "achievements of the Romans in the field of water supply with the… 'glorious but useless monuments of the Greeks'."[9] Frontinus relegated certain aqueducts and waters for certain uses and other aqueducts and water sources for others, as well

work. Cf. R.E. Wycherley *How the Greeks Built Cities* (Toronto: MacMillan, 1962: 199) for more on the Greek aqueduct.

[8] An example from popular culture: one might think of the quote from Monty Python's *Life of Brian* about what the Romans brought to Judea and the countries they conquered where the first benefits of colonization are cited as the aqueduct and sanitation (https://www.youtube.com/watch?v=Qc7HmhrgTuQ).

[9] E.J. Owens, "The Kremna Aqueduct and Water Supply in Roman Cities," in *Greece & Rome*, vol. 38, no 1 (UK: Cambridge University Press on behalf of the Classical Association, 1992): 41. Frontinus, *De Aqueductu* 1.16: Tot aquarum tam multis necessariis molibus pyramidas videlicet otiosas compares aut cetera inertia sed fama celebrata opera Graecorum. Sourced from the Loeb Classical Library Online.

as arranging the efficient collection of wastewater.[10] Of course, Rome had long used the *Cloaca Maxima* for the movement of sewage and drainage, but with Frontinus' efforts cleanliness and health in the city improved.

In his account of the Peloponnesian War, Thucydides describes dying citizens clamouring around the fountain houses of the city during the Plague of Athens.[11] Thucydides' account emphasizes the communal nature of the fountain houses and shows that some Athenians did not have access to private wells, depending instead on the public fountains of the city for their water. This gives us an idea of the importance and usage of public fountain houses but also an idea of how public they really were. It seems unlikely that foreigners and *metics* were barred from using the fountains, so any person in the city had access to these spaces. Inhabitants of the city did not have any reason to worry that their access to the fountains would be restricted and knew that their right to visit the public springs was inalienable even under a plague.[12] Thucydides goes on to say that during the Siege of Athens in the Peloponnesian War, most of the people living in the surrounding country outside the city were moved inside the walls but were not given housing, with many even living in empty sanctuaries, and therefore would have depended even more on public services like the many fountain houses and springs. This dependence on and daily use of public fountains suggests equality of access to the means of survival and also supports the idea

[10] Harold Abrahams, "The Water Supply of Rome," in *Journal (American Water Works Association)*, vol. 67, no. 12 (US: Wiley, 1975): 667.

[11] Thucydides, *Histories,* 2.52: ἐπίεσε δ' αὐτοὺς μᾶλλον πρὸς τῷ ὑπάρχοντι πόνῳ καὶ ἡ ξυγκομιδὴ ἐκ τῶν ἀγρῶν ἐς τὸ ἄστυ, καὶ οὐχ ἧσσον τοὺς ἐπελθόντας. οἰκιῶν γὰρ οὐχ ὑπαρχουσῶν, ἀλλ' ἐν καλύβαις πνιγηραῖς ὥρᾳ ἔτους διαιτωμένων ὁ φθόροςἐγίγνετο οὐδενὶ κόσμῳ, ἀλλὰ καὶ νεκροὶ ἐπ' ἀλλήλοις ἀποθνῄσκοντες ἔκειντο καὶ ἐν ταῖς ὁδοῖς ἐκαλινδοῦντο καὶ περὶ τὰς κρήνας ἁπάσας ἡμιθνῆτες τοῦ ὕδατος ἐπιθυμίᾳ. τά τε ἱερὰ ἐν οἷς ἐσκήνηντο νεκρῶν πλέα ἦν, αὐτοῦ ἐναποθνῃσκόντων: ὑπερβιαζομένου γὰρ τοῦ κακοῦ οἱ ἄνθρωποι, οὐκ ἔχοντες ὅτι γένωνται, ἐς ὀλιγωρίαν ἐτράποντο καὶ ἱερῶν καὶ ὁσίων ὁμοίως. Greek sourced from Perseus Tufts. Cf. John McKesson II Camp, *The Archaeology of Athens* (New Haven: Yale University Press, 2004): 117-118.

[12] This is unlike the Canadian government's response during the Covid-19 pandemic quarantine in 2020-2021, which saw the closure of public drinking fountains and bathrooms that the unhoused and even housed populations depend on. Of course, this was due to the advanced knowledge of the spread of contagious diseases and viruses that we have in the modern day, but with no provisions made for citizens in place of these public waterworks, many city residents—particularly in large cities—suffered.

that those who funded the construction of a fountain house would not easily be forgotten by the inhabitants of the city.

Hippokrates' treatise for wandering physicians, *On Airs, Waters, Places*, emphasizes the importance of water in the ancient world. Hippokrates writes at length about how different waters drunk from certain places affect the health of the drinker: stagnant water, hard water, salt water, rainwater, snow water, and spring and well water, almost all of which vary further in how bad or good they are for the body depending on their cardinal orientation. The most relevant quotation from Hippokrates for this work pertains to what makes a desirable water source.

> "The best are those which flow from elevated grounds, and hills of earth; these are sweet, clear, and can bear a little wine; they are hot in summer and cold in winter, for such necessarily must be the waters from deep wells. But those are most to be commended which run to the rising of the sun, and especially to the summer sun; for such are necessarily more clear, fragrant, and light. But all such as are salty, crude, and harsh, are not good for drink. But there are certain constitutions and diseases with which such waters agree when drunk, as I will explain presently. Their characters are as follows: the best are such as have their fountains to the east; the next, those between the summer risings and settings of the sun, and especially those to the risings; and third, those between the summer and winter settings; but the worst are those to the south, and the parts between the winter rising and setting, and those to the south are very bad, but those to the north are better."[13]

This treatise is a good example of the rudimentary understanding of environmental factors and their effects on human health in antiquity. Hippokrates also writes about how the different

[13] Hippokrates, *On Airs, Waters, Places,* "Part 7", translated by Francis Adams (Online: Web Atomics, 1994-2009). ἄριστα δὲ ὁκόσα ἐκ μετεώρων χωρίων ῥεῖ καὶ λόφων γεηρῶν. αὐτά τε γάρ ἐστι γλυκέα καὶ [60] λευκὰ καὶ τὸν οἶνον φέρειν ὀλίγον οἷά τέ ἐστιν. τοῦ δὲ χειμῶνος θερμὰ γίνεται, τοῦ δὲ θέρεος ψυχρά. οὕτω γὰρ ἂν εἴη ἐκ βαθυτάτων πηγέων. μάλιστα δὲ ἐπαινέω ὧν τὰ ῥεύματα πρὸς τὰς ἀνατολὰς τοῦ ἡλίου ἐρρώγασι καὶ μᾶλλον πρὸς τὰς θερινάς. ἀνάγκη γὰρ λαμπρότερα εἶναι καὶ εὐώδεα καὶ κοῦφα. ὁκόσα δέ ἐστιν ἁλυκὰ καὶ ἀτέραμνα καὶ σκληρά, ταῦτα μὲν πάντα πίνειν οὐκ ἀγαθά: εἰσὶ δ᾽ ἔνιαι φύσιες καὶ νοσεύματα, ἐς ἃ ἐπιτήδειά ἐστι τὰ τοιαῦτα ὕδατα πινόμενα, περὶ ὧν φράσω αὐτίκα. ἔχει δὲ περὶ τούτων ὧδε: ὁκόσων μὲν αἱ πηγαὶ πρὸς τὰς ἀνατολὰς ἔχουσι, ταῦτα μὲν ἄριστα αὐτὰ ἑωυτῶν ἐστι: δεύτερα δὲ τὰ μεταξὺ τῶν θερινῶν ἀνατολέων ἐστὶ τοῦ ἡλίου καὶ δυσίων, καὶ μᾶλλον τὰ πρὸς τὰς ἀνατολάς: τρίτα δὲ τὰ μεταξὺ τῶν δυσμέων τῶν θερινῶν καὶ τῶν χειμερινῶν: φαυλότατα δὲ τὰ πρὸς τὸν νότον καὶ τὰ μεταξὺ τῆς χειμερινῆς ἀνατολῆς καὶ δύσιος. καὶ ταῦτα τοῖσι μὲν νοτίοισι πάνυ πονηρά, τοῖσι δὲ βορείοισιν ἀμείνω. Greek sourced from Perseus Tufts. Most commentaries characterize these cardinal directions as the direction of flow that the rivers should run in, but this is not so clear in the Greek. Hippokrates indicates the flow when talking about the best source for a spring but refrains from using any clear physical language when he turns to the directions. This is based on my own analysis of the Greek on Perseus.

terrain that people live in changes their natures and affects their intelligence, bravery, and hardiness, in large part due to the variety of water throughout the world. Hippokrates contends that rainwater is good after it has been boiled; however, rainwater becomes harmful when it is allowed to become stagnant. Stagnant water is terrible for health. Springs are the best source of water, though the taste and benefits of these waters vary depending on the orientation and sources of the spring. The best sources for springs are those that come from "elevated grounds and hills of earth" (Hp.*Aer.*7), much like Athens' Mount Hymettos. East flowing springs and rivers are best, especially when hit by the light of the rising sun, northbound waters are second best, westbound are third, and southerly waters are the worst.[14] Hippokrates also disparages those waters that flow from rock as being too full of minerals for healthy people to drink, which is interesting, given that many springs in the ancient world were rock-cut springs. The presence of springs flowing from rocks are well-attested at many temples and in Athens alone there were at least two rock-source springs on the Akropolis and another near the Pnyx.[15]

The treatise was published after extensive development in the classical agora in Athens. Despite the treatise's later date, Hippokrates' theories on good and bad water are effectively illustrated through the transition from the old water systems of the archaic Athenian agora to the classical agora. In the archaic period, the water landscape of the Athenian agora was

[14] Jacques Jouanna, "Water, Health, and Disease in the Hippocratic Treatise *Airs, Waters, Places*," in *Studies in Ancient Medicine: Greek Medicine from Hippocrates to Galen, Volume 40*, trans. Neil Allies, ed. John Scarborough, Philip van der Eijk, Ann Ellis Hanson, and Joseph Ziegler (Netherlands: Brill, 2012): 165.

[15] On the Akropolis there was the Klepsydra spring, the spring in the Asklepeion, and near the Pnyx, Kallirhoe (which may be the site of Thucydides' Enneakrounos). The Mycenaean well shaft cut down to the groundwater in the Akropolis and so did not come from a naturally-occurring spring but instead indicates a desire for a protected water source in case of siege or some other impediment preventing those on the summit of the Akropolis from reaching the springs further down the hill. Cf. Oscar Broneer, "A Mycenaean Fountain on the Athenian Acropolis" (*Hesperia*, vol. 8, no. 4, 1939), and Seraphina Vasilodimitrakis-Hart, "ἄριστον μέν ὕδωρ: An Examination of the Public Waterworks in Athens in the Early 5thC BCE," in *Past Imperfect* (Canada: University of Alberta Press, 2021) for further discussion of the Mycenaean well on the Akropolis.

characterized by private wells and cesspits for individual houses, and considerable marshland.[16] The stagnant, silty water run-off in the archaic agora and the still water of the many wells, corresponds well to the warnings expressed by Hippokrates. Stagnant water is by far the worst kind of water, it is never good for drinking, and this is what was most present in the agora. This is actually a fair characterization of stagnant water, since it is a breeding ground for mosquitoes and water-borne diseases. Stagnant water would have been quite deadly in antiquity, though disease and parasites can still flourish in running water. The wells in the area, necessarily drawing from the groundwater, would likely have been drinkable but the smell from the sewage in the cesspits and the pools of stagnant run-off water nearby could not have given the water from the ground of the agora a great reputation.

Hippokrates is certainly not alone in mapping beneficial environments on to cardinal directions. Aristotle in the *Politics*—drawing on a wider medicinal tradition and perhaps even Hippokrates' treatise—contends that the best location for a city is an east-facing slope, while one to the north is second best, and immediately after highlights the importance of easy access to 'pure' water (Aristot., *Pol.*1330a34-1330b8).[17] He also insists that cisterns are needed in case war strains the waterways of the city (*Pol*.vii.1330b). In the 320s BCE, when he wrote the *Politics*, there was a severe drought that lasted twenty-five years. Because of the drought, the city prioritized better methods of storing rainwater and "cisterns were built in the Athenian agora for the first time in centuries."[18] Evidently secure water sources were of particular concern for the city and for Aristotle at this time.

[16] Crouch (1993).
[17] Aristotle, *Politics,* trans. T.A. Sinclair, revised by Trevor Saunders (England: Penguin Books Ltd., 1957): 421-422.
[18] Crouch, 1993: 52.

Plato likewise gives the environmental surroundings and the quality of the water of a city an important role in the development of good and bad character in its citizens (Plat., *Laws* 5.747).[19] The office of superintendent of public water is referenced in both Aristotle's *Athenaion Politeia* (*Ath.Pol.*43.1) and Plato's *Laws* (*Laws* 758e and 764b). Plato speaks to the importance of this role in the functioning of the city, while Aristotle mentions that it was an elected position, not one of the many chosen by lot.[20] That it was an elected position suggests that a level of competence and knowledge was expected in those running for superintendent; it was not a position that any citizen could fill.

Plato outlines plans for the ideal city extensively in the *Republic*, with some thought given to the physical division of the land but with more consideration given to the division of social classes. However, in the *Critias,* he also discusses Atlantis and its urban plan, which he describes as being divided into concentric rings. Even Aristophanes mentions orthogonal street planning and the division of land in both the *Birds* (995-1010) and the *Clouds* (202-204). Urban planning was a public consideration, a concern for many Athenian citizens.

R.E. Wycherley credits the Ionian cities in Asia Minor—such as Miletos—with the invention of orthogonal city planning and, indeed, with urban planning in general in the 6th and 5th centuries BCE, writing that "there is little sign of planning in the western colonies until comparatively late."[21] Graham Shipley, on the other hand, writes that "Hellenic grid-planning began in the Greek colonies of Sicily and southern Italy in the late 8th and particularly the 7th century," agreeing with the archaeological record.[22] Because interpretations of Aristotle credit

[19] Plato, *Laws*, trans. with introduction by Trevor Saunders (England: Penguin Books Ltd., 1970): 219.
[20] Maura Brennan, "A Comparative Analysis of Five Greek Fountain Houses" (Virginia: Unpublished dissertation at the College of William and Mary, 2015): 2.
[21] Wycherley, 1962: 15.
[22] Graham Shipley, "Little Boxes on the Hillside: Greek Town Planning, Hippodamos, and Polis Ideology," in *The Imaginary Polis*, ed. Mogans Herman Hansen (Copenhagen: The Royal Danish Academy of Science and Letters, 2005): 337. As Wycherley was writing in the 1960s, without the benefit of recent scholarship, it is understandable

Hippodamos with inventing the rectilinear division of cities, it was long thought that he was the inventor of orthogonal city planning in general. This is not the case as there is evidence of grid streets in Egypt before the 5th century and many cities including Akragas and Metaponto—a Dorian settlement founded in the 6th century, and an Achaean settlement founded in the second half of the 7th century, respectively—were laid out long before Hippodamos lived.[23]

The water management systems at these two sites and their grid layouts suggest a level of deliberate planning that should not be overlooked in the history of urban planning. Greek colonies often show evidence of intentional city design, since the colonists had the opportunity to improve their home *poleis* when founding new *apoikiai* and could plan the city around hypothetical, larger, future populations than the founding population. Intentional urban planning allows the city to grow more quickly and, ideally, more smoothly and with more resources than over several generations of unplanned, sprawling urbanization. The necessity of access to water in the city means that water management is an essential part of siting and establishing a city, so that water management is inseparable from urban planning. Urban planning *is* water management.

Despite even the earliest estimates of Hippodamos of Miletos' birth placing him centuries after the earliest planned Greek cities, Hippodamos has become synonymous with the orthogonal street grid found in many Greek cities from the archaic period onward. The term "Hippodamian" refers to this connection between Hippodamos and the city grid and has been used most often in

how he made this error, however, an effort to debunk this view of Hippodamos and Ionian city-planning is only starting to become common knowledge now. Because of this, I feel it is important to acknowledge this erroneous viewpoint.

[23] Wycherley and other textualists have been disproved by the architectural record, which demonstrates that orthogonal streets existed in the Greek world from the 8th century, but as early as the 4th millennium BCE across the Mediterranean and in Western Asia and Mesopotamia.

modern scholarship.[24] Contemporary scholarship has shifted away from identifying all ancient grid cities with Hippodamos, since the Hippodamian label credits Hippodamos with the invention of orthogonal planning or implies his direct involvement in the planning of the city, which has now been debunked. Scholiasts in antiquity apply this label uncritically, which confuses the origin of this method of urban planning. The orthogonal street plan found at Akragas and Metaponto is found throughout the Greek world, conspicuously at Piraeus, the port of Athens. After the destruction of Athens in the Persian War, much of the city had to be redesigned, and Hippodamos was chosen to redesign the port, a post that garnered him great renown. Aristotle connects Hippodamos with this type of city planning because Hippodamos introduced it to Athens when he rebuilt the Piraeus.[25]

Much of what we know about Hippodamos comes from Aristotle's *Politics*. He was a politician and a reformer, a theoretician, and a city planner. He is sometimes credited with taking part in the rebuilding of his hometown, Miletos, in 479 BCE and also the design of Rhodes in 408 BCE, although the likelihood that he oversaw both of these projects continues to be debated among scholars.[26] Aristotle describes Hippodamos' orthogonal street plan as the best design for residential areas, writing, "As for the layout of private dwelling-houses, the modern or Hippodamian scheme of regularity is more attractive and more useful… arrang[ing] the buildings in the same pattern as is used in fields for planting vines."[27]

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[24] Shipley, 2005: 337. Wycherley, for example, writes that he "feel[s] justified in labelling the Greek method Hippodamian" (1962: 18), since the connection between Hippodamos and the grid plan is so well-attested, but I prefer to refer to this method of city planning as "orthogonal" or "grid" planning.

[25] Alfred Burns, "Hippodamus and the Planned City," in *Historia: Zeitschrift für Alte Geschichte*, 4th quarter (1976): 421.

[26] Burns (1976) presents a good overview of the issues with Hippodamos' chronology and how these projects might fit within a timeline. Hippodamos is also sometimes called the designer of Thurii, having gone as a colonist to the new city.

[27] Aristot. *Pol*. 1330b24, translated by T.A. Sinclair, 1957. ἡ δὲ τῶν ἰδίων οἰκήσεων διάθεσις ἡδίων μὲν νομίζεται

In the *Politics*, Aristotle outlines how a *chora* should be divided: either as "a private, divided land assigned to individuals and families" or as "undivided or communal land."[28] For the *asty,* he outlines the perfect division of a city—based on an urban planning theory he attributes to Hippodamos. He writes: "It was he who invented the division of cities into precincts, and he also laid out the street-plan of the Piraeus… Hippodamos planned a state of 10,000 divided into three parts… a sacred, a public, and a private."[29] The city should be divided between the sacred, temples and the like; the public, civic buildings, the agora, water fountains; and the private, or residential. These three categories complement each other and work together to make a well-functioning city.[30] By attributing this tripartite division of the city and the invention of orthogonal street planning to Hippodamos, Aristotle credits him with involvement in all aspects of city planning.

Modern scholars have also sometimes attributed to Hippodamos the invention of a "unified architectural plan for the buildings framing the agora": one with a central rectangular agora surrounded by buildings, that developed and became very popular in Ionian cities in the Hellenistic period.[31] There is no real evidence from antiquity for this claim. Instead, Alfred Burns (1974), in agreement with F. Castagnoli (1971) and I.D. Kondis (1956), suggests that the Hippodamian street grid was not just a simple layout of city blocks and street intersections. It

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καὶ χρησιμωτέρα πρὸς τὰς ἄλλας πράξεις, ἂν εὔτομος ᾖ καὶ κατὰ τὸν νεώτερον καὶ τὸν Ἱπποδάμειον τρόπον… ἐνδέχεται γάρ, ἄν τις οὕτως κατασκευάζῃ καθάπερ ἐν τοῖς γεωργοῖς ἃς καλοῦσί τινες τῶν ἀμπέλων συστάδας. Greek sourced from Perseus Tufts.

[28] Alberto Prieto, *Landscape Organization in Magna Grecia* (Austin: University of Texas, 2005): 44, drawing on Aristot. *Pol.* 1330a9-11.

[29] Aristot. *Pol*. 1267b30, translated by T.A. Sinclair. πρῶτος τῶν μὴ πολιτευομένων ἐνεχείρησέ τι περὶ πολιτείας εἰπεῖν τῆς ἀρίστης. κατεσκεύαζε δὲ τὴν πόλιν τῷ πλήθει μὲν μυρίανδρον, εἰς τρία δὲ μέρη διῃρημένην: ἐποίει γὰρ ἓν μὲν μέρος τεχνίτας, ἓν δὲ γεωργούς, τρίτον δὲ τὸ προπολεμοῦν καὶ τὰ ὅπλα ἔχον. διῄρει δ᾽εἰς τρία μέρη τὴν χώραν, τὴν μὲν ἱερὰν τὴν δὲ δημοσίαν τὴν δ᾽ἰδίαν. Greek sourced from Perseus Tufts.

[30] This division of the city may bring to mind Plato's division of the city, which is based on his three categories of people in the ideal city (guardians, auxiliaries, and producers), part of an analogy to explain his concept of the tripartite division of the soul.

[31] Burns, 1976: 419, 421.

was instead the "division of the city into long narrow sections by a small number of parallel wide avenues… cut up into oblong blocks by narrow streets of alleyways," within a holistic plan of the city, "integrating physical, social, hygienic, and aesthetic factors."[32] Vanessa Gorman offers a similar interpretation of Aristotle, crediting Hippodamos with developing a theory of urban planning that involved the division of land and classes in cities.[33] Essentially, these scholars credit Hippodamos as the innovator of a kind of 'total' city planning through land-allotment, 'masterplanning,' not only as the inventor of grid planning.[34]

Although most of the extant urban theories from antiquity come from the classical period or later, these theories existed long before the 5th century. All of these ancient writers built on the works of the Pre-Socratic natural philosophers; in Hippokrates alone the influence of Anaximander of Miletus and Diogenes of Apollonia can easily be seen.[35] Even the importance of proper water management is reflected by the Pre-Socratics: Thales of Miletos declared that the world and everything in it came from water (Vitr. 2.2), while Heraclitus meditated on the essential changeability of the world through a metaphor about flowing rivers.[36] The similarity of these theories suggests that the idea that environmental factors have an effect on citizens' bodies and characters was at least already established by the 5th century. It may have even affected the

[32] Alfred Burns, "Ancient Greek Water Supply and City Planning: A Study of Syracuse and Acragas," in *Technology and Culture*, vol. 15, no. 3 (1974): 401-402, fn. 25.
[33] Vanessa Gorman, "Aristotle's Hippodamos ('Politics' 2.1267b22-30)," in *Historia: Zeitschrift für Alte Geschichte*, 4th qtr. Germany: Franz Steiner Verlag, (1995).
[34] "Total city planning" is my term for what Burns calls a "concept of a master plan of the city" (1974: 401-402, fn. 25), which "allocate[s] in advance the area[s] of the city for various needs" (1976: 415) Burns and I are making a distinction between the design of just a street plan with no consideration of how those streets interact with or dictate the actual use of the city, and designing a city with different sectors dedicated to specific uses and fulfilling specific needs. Having consulted several urban design company websites, I have found that the apparent analogue for this kind of urban plan is "masterplanning". Cf. ClearPoint Strategy; WSP; ARUP.
[35] Jouanna, 2012: 163.
[36] Jamie Linton, *What is Water? The History of a Modern Abstraction* (Vancouver: UBC Press, 2009): 4.

planning of Metaponto and Akragas. It is impossible to know if these ideas were deliberately put into practice in the planning and building stages, but it does seem plausible and even likely.

Many of the Greek voices on urbanism that have survived to the modern-day focus on or are framed by Athens, a result of the city's supremacy in the archaic and classical periods and its continued cultural production in the Hellenistic period. Modern scholarship has also historically privileged Athens in the study of water management in antiquity and ancient urbanism, in part because of the plethora of Athenian voices, but also because of the extensive archaeological record and study at Athens.[37] This focus is shifting as scholars acknowledge the great amount of material to be studied outside mainland Greece, particularly in the Eastern and Western Greek colonies. Nevertheless, the prevalence of Athens in this field therefore warrants a brief examination of some of the city's water systems in this study, especially as a means of comparison for the systems in place at Akragas and Metaponto.

The area that would later become the classical agora [fig. 1][38] always had problems with water access. In the 8th century, many of the wells in the district fell out of use, and there appears to have been something like a drought sweeping Athens, based on the many votive objects found at the Mount Hymettos shrine to Zeus Ombrios and the Sanctuary of Artemis at Brauron.[39] Up until the mid 6th century the area had been primarily residential, with private wells. Peisistratos relocated the residences and closed these wells, opening the space up to development. In the second half of the 4th century, again, there was an issue with drought. As the population grew, the water-table of the classical agora was lowered. In an effort to mitigate this, individuals

[37] Rome and Athens—as centres of the Roman and Greek worlds, respectively—have both been the greatest focus for studies in ancient urbanism and water management. However, Rome has the added benefit of Vitruvius and Frontinus, allowing modern scholarship to focus on the engineering and administrative prowess of the Romans.
[38] Images begin on page 57.
[39] Camp, 2004: 24.

collected rainwater in roughhewn stone cisterns, underground channels were expanded, and new aqueducts and fountains were built.[40] Larger public fountains required less maintenance and supplied great quantities of water more efficiently than many private wells. This was true in the 6th and 5th centuries as well, and governments hoping to remain popular and maintain power could embark on these building projects.

Serious droughts affected the agora area in antiquity, but the main problem of the space was an abundance of run-off water from the surrounding hills. The agora is in an hydrologic basin, also called the agora sub-basin.[41] Surrounding it are many limestone-topped hills and mountains which formed during the Cretaceous period and act as decent reservoirs for rainwater,[42] the rest of the land is dry because it can only take in about 5% of the torrential rain that occurs in the area every year due to most of the land and especially the flatland being covered in schist.[43] This means most of the accumulated water becomes surface run-off instead of groundwater. The run-off creates heavy silt deposits in the flat areas of the agora, which was an issue in early excavations until the Great Drain was uncovered [fig. 7b].[44] Before the initial construction of the Great Drain, when the agora was still mostly residential and industrial, the area was marshy, due to run-off accumulation in the sub-basin and contained many cesspits. Cesspits have a pungent stench, and often leak seepage into the surrounding water table and pollute the water.

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[40] Camp, 2004: 159-160.
[41] E.D. Chiotis and L.E. Chioti, "Drainage and Sewerage Systems at Ancient Athens, Greece", in *Evolution of Sanitation and Wastewater Technologies through the Centuries*, ed. A.N. Angelakis and J.B. Rose (London: IWA Publishing, 2014): 319.
[42] E.D. Chiotis and L.E. Chioti, "Water Supply of Athens in the Antiquity", in *Evolution of Water Supply Through the Millenia*, ed. Andreas Angelakis, Larry Mays, Demetris Koutsoyiannis, and Nikos Mamassis (London: IWA Publishing, 2012): 413.
[43] Chiotis and Chioti, 2014: 315.
[44] Homer Thompson and R.E. Wycherley, *The Athenian Agora XIV: The Agora of Athens the History, Shape, and Use of an Ancient City Center* (New Jersey: The American School of Classical Studies at Athens, 1972): 194.

The Southeast Fountain House sourced its water from the Ilissos River, springing from Mount Hymettos to the east, which of course means that the pipe system carried the water into the west. Because the river and its source are located east of the city, it is possible that this was considered east enough for the Athenians' purposes, or perhaps the theories found in Hippokrates were not as widespread and influential before his treatise as they appear. The spring from which the river flows could easily have been east, north, or west-facing, but was at least fully removed from the tainted Eridanos. The agora was already a place of industry, with many potteries and tanneries in the nearby Kerameikos that emptied their wastewater into the Eridanos River and used the clay from the banks of the river. The smell, debris, and silty clay of these industries, along with the seepage and stench of the cesspits, indicates that the Eridanos would not have been an acceptable source of water for the developing marketplace and civic centres.[45] The Ilissos also had a higher volume than the Eridanos, and was likely more reliable. Recognizing this, no matter when the Southeast Fountain House was built, it certainly would not have sourced its water from the Eridanos, even though it was so conveniently close.

The Eridanos water was not potable in the 6th century and after the construction of the Great Drain two channels ran "along the north-south street west of the Painted Stoa," in the northwest corner.[46] One of these channels drew water north, uphill through pressurized pipes, while the other—a southbound sewerage drain—used gravity to empty some of the stormwater and waste into the Eridanos, further polluting the river.[47] Perhaps, then, Hippokrates' theories

[45] Considering that there were also many burials in the area and the ancient Greek attitude towards desecration of the dead and the pollution caused by corpses, it seems this was also likely a contributing factor to the reluctance to drink from this river. It is interesting that the people of Metaponto did not seem to consider this issue when building the canals along the division lines and necropoleis (Cf. Chapter 2). Perhaps because the canals were primarily used for irrigation rather than for drinking water.
[46] Chiotis and Chioti, 2014: 318.
[47] Chiotis and Chioti, 2014: 318. A. Gottesman, *Politics and the Street in Democratic Athens* (Cambridge: Cambridge University Press, 2014): 31-34

were at work in the construction of the Great Drain system [fig. 7a] and even the Southeast Fountain House.

Even in Athens, in the heart of scholarship, there is still uncertainty.[48] The Southeast Fountain House, for example, is of unknown provenance and date, but whether it is of democratic or tyrannical construction, these systems and buildings were needed and used regardless of authorship. The identification of the fountain house located in the southeast corner of the Athenian classical agora is complicated by conflicting ancient sources and by the archaeological record itself. Pausanias identifies it with the famous Enneakrounos fountain built by Peisistratos and his sons, which Thucydides places elsewhere south of the Akropolis. However, the archaeological evidence does not suggest that a grand, tyrannical building project, with a nine-spouted fountainhead ever existed in the southeast corner of the agora. Further complicating its identification is new scholarship by Jessica Paga (2015) disputing the late 6th century date previously accepted for the structure.

Thucydides reports that the original city of Athens consisted of the hilltop citadel and the area south of the Akropolis.[49] His proof for this claim is that there are temples and shrines on the Akropolis and likewise there are many more sanctuaries in the southern part of the city. While he is still referring to this southern area, he mentions the fountain house, Enneakrounos of Peisistratos. This would put the fountain close to the Ilissos river, as many ancient sources attest,

[48] Cf. John Papadopoulos, "The Original Kerameikos of Athens and the Siting of the Classical Agora," in *Greek, Roman, and Byzantine Studies*, vol. 37 is. 2 (USA: Duke University Press, 1997); Jessica Paga, "The Southeast Fountain House in the Athenian Agora: A Reappraisal of Its Date and Historical Context," *Hesperia*, vol. 84, no. 2 (2015); E.J. Owens, "The Enneakrounos Fountain-House," in *The Journal of Hellenic Studies*, vol. 102 (1982).
[49] Thuc.2.15-16. Particularly 2.15.3-5: τὸ δὲ πρὸ τοῦ ἡ ἀκρόπολις ἡ νῦν οὖσα πόλις ἦν, καὶ τὸ ὑπ᾽ αὐτὴν πρὸς νότον μάλιστα τετραμμένον… καὶ τῇ κρήνῃ τῇ νῦν μὲν τῶν τυράννων οὕτω σκευασάντων Ἐννεακρούνῳ καλουμένῃ, τὸ δὲ πάλαι φανερῶν τῶν πηγῶν οὐσῶν Καλλιρρόῃ ὠνομασμένῃ ἐκεῖνοί τε ἐγγὺς οὔσῃ τὰ πλείστου ἄξια ἐχρῶντο. Greek sourced from Perseus Tufts.

including Plato, Philostephanos, Statius, and Herodotos.[50] Thucydides specifies that the Enneakrounos fountain had a sacred role in weddings and rituals, which might make it unsuitable for daily use. He also outlines a change in the name and usage of the fountain, writing, "The people in those days [before Peisistratos] used to use th[e Kallirhoe] spring for all purposes since it was so close to them." The Ilissos River was also considered somewhat sacred, as one of the muses' favoured sites was the Ilissos riverbed, and Ilissos was a son of Poseidon.[51] Many shrines and sanctuaries dotted the slopes of Mount Hymettos, most of them close to the river or its feeder springs and creeks. The sacred nature of Thucydides' Enneakrounos would fit in well on the banks of the Ilissos.

Most of the other sources seem to build on Thucydides' identification of the fountain as the Kallirhoe spring and do not aid scholars in identifying the actual structure.[52] Herodotos places the Enneakrounos near the base of Mount Hymettos, which easily complements the fountain's location in Thucydides. But his account contains problems as well since he relates a story from early in the city's history about an Enneakrounos. It seems relatively certain—though nothing else does—that this was the name given to the fountain only after the Peisistratid embellishment in the 6th century BCE.[53]

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[50] R.E. Wycherley, *The Athenian Agora III: Literary and Epigraphical Testimonia* (New Jersey: The American School of Classical Studies at Athens, 1957): 137-142.
[51] Ion Frantzeskakis, "By the Banks of the River Ilissos", on *Athens Key* (Online: 2020).
[52] There is a Kallirhoe spring positively identified in a cave near the Pnyx, south (west) of the Akropolis which could be the site of the fountain. It aligns nicely with Thucydides description of a south, near and convenient spring coming straight from the earth, and is also near the Ilissos River. However, 'Kallirhoe', 'fair stream', is a common name for a spring throughout the Greek world and the modern cave entrance might suggest that the spring was too small for a tyrant's monumental fountain. It is also near the Pnyx and Areopagus, both areas associated with the early democracy and the end of the tyranny, which might deter an identification with the Enneakrounos.
[53] Herodotos, *Histories*, 6.137.3: ὡς δὲ αὐτοὶ Ἀθηναῖοι λέγουσι, δικαίως ἐξελάσαι. κατοικημένους γὰρ τοὺς Πελασγοὺς ὑπὸ τῷ Ὑμησσῷ, ἐνθεῦτεν ὁρμωμένους ἀδικέειν τάδε. φοιτᾶν γὰρ αἰεὶ τὰς σφετέρας θυγατέρας τε καὶ τοὺς παῖδας ἐπ᾽ ὕδωρ ἐπὶ τὴν Ἐννεάκρουνον: οὐ γὰρ εἶναι τοῦτον τὸν χρόνον σφίσι κω οὐδὲ τοῖσι ἄλλοισι Ἕλλησι οἰκέτας: ὅκως δὲ ἔλθοιεν αὖται, τοὺς Πελασγοὺς ὑπὸ ὕβριός τε καὶ ὀλιγωρίης βιᾶσθαι σφέας. Greek sourced from Perseus Tufts. Wycherley, 1957: 138.

In contrast, when Pausanias mentions the Enneakrounos,[54] he is referring to the classical agora, north of the Akropolis.[55] Pausanias appears to have been mistaken when we look at Thucydides' placement of the Enneakrounos.[56] Thucydides and Pausanias must be describing two different fountain houses; Thucydides about the Enneakrounos on the banks of the Ilissos or describing a now-lost fountain dedicated by Peisistratos in an older agora and Pausanias about the Southeast Fountain House in the classical agora.[57] This interpretation privileges Thucydides' identification over Pausanias'. However, Thucydides wrote as a resident of Athens about a century after the construction of the fountain, while Pausanias wrote as a traveller in the 2nd century CE. It is easy to believe that he may have conflated his facts or had been given incorrect information.[58]

E.J. Owens suggests that the Enneakrounos of Thucydides' time [fig. 2a] was in fact located somewhere in the southeast of the city near the Ilissos River, but by the time Pausanias visited Athens, that fountain house had been destroyed and the name transferred to a different Peisistratid fountain: the Southeast Fountain House.[59] This is plausible, since many alterations

[54] Pausanias, *Description of Greece,* trans. W.H.S. Jones and H.A. Ormerod (Cambridge: Harvard University Press, 1918). Paus. 1.14.1: πλησίον δέ ἐστι κρήνη, καλοῦσι δὲ αὐτὴν Ἐννεάκρουνον, οὕτω κοσμηθεῖσαν ὑπὸ Πεισιστράτου: φρέατα μὲν γὰρ καὶ διὰ πάσης τῆς πόλεώς ἐστι, πηγὴ δὲ αὕτη μόνη. Greek sourced from Perseus Tufts.

[55] There is some debate over the actual area that Pausanias describes. It has been widely accepted that the space he calls *Kerameikos* and agora (which is only used once or twice) is the classical agora that we can see today. However, Christopher Dickenson, "Pausanias and the 'Archaic Agora' at Athens," *Hesperia*, vol. 84, no. 4 (2015), argues convincingly that *Kerameikos* refers to the classical agora while agora refers to the Roman agora. It seems likely that these two words could denote different places, but also that the archaic agora was no longer visible in Pausanias' time. Cf. also: Papadopoulos (1997).

[56] Paga, 2015: 360.

[57] Paga, 2015: 360. Here, I assume the existence of two Greek agorai: an archaic agora and a classical agora. Cf. Dickenson (2015); Paga (2015); Robin Osborne, "Did Democracy Transform Athenian Space?" *Building Communities: House, Settlement and Society in the Aegean and Beyond*, vol. 15 (2007); Richard T. Neer and Leslie Kurke, "Pindar Fr. 75 SM and the Politics of Athenian Space", in *Greek, Roman, and Byzantine Studies,* vol. 54 (2014); etc.

[58] Pausanias did not follow a strict ambulatory path and often doubles-back to discuss monuments he should have already passed [fig. 3], which further confuses scholars' ability to identify structures in the agora. From the so-called Enneakrounos, Pausanias talks about the Eleusinion, identified as being on the Akropolis' north slope, and backtracks to the Hephaistion and temple of Artemis, which he would have passed before.

[59] Owens, 1982: 225.

were made to the city's waterways in the 4th century, but the only possible literary corroboration for this idea is a brief comment by Herodotos on the existence of an Enneakrounos spring that lost its name to a different fountain in the southern part of the city.

Further complicating Owens' hypothesis is the problem of dating the Southeast Fountain House. If the name was given to another Peisistratid fountain, that fountain would have to date to the 6th century. The question of when the Southeast Fountain House was built is a complicated one and is up for some debate. It has been generally accepted since its uncovering, to date from the second half of the 6th century. Despite scholars moving away from the identification of the Southeast Fountain House with the Enneakrounos, the Peisistratid date has remained. John M. Camp puts it more precisely at 530-520 BCE to coincide with the end of Peisistratos' tyranny or the beginning of his sons'.[60] Paga, however, contends that the Southeast Fountain House is inextricably linked to the development of the classical and democratic agora.[61]

Paga argues that although earlier scholarship identified the Southeast Fountain House with Peisistratos' Enneakrounos on the basis of Pausanias' testimony, this is an incorrect identification according to architectural conventions, ceramic evidence buried beneath the structure, the pipelines, and the physical structure itself. Instead, she proposes a date of around 480-450 BCE, to coincide with the rapid development in the agora.[62] Camp and Paga point to the same architectural features, like polygonal masonry and the Z-clamp, in order to argue for different construction periods.[63]

[60] Camp, 2004: 35.
[61] Paga, 2015: 362.
[62] Paga, 2015: 356. Paga also discusses the use of the claw-tooth chisel [fig. 6a, 6b] on the fountain and its implications. For more on the use of the claw-tooth chisel on the Akropolis, see Jessica Paga, "The Claw-Tooth Chisel and the Hekatompedon Problem: Issues of Tool and Technique in Archaic Athens," in *Athenische Mitteilungen* 127 (Berlin: Gebr. Mann Verlag, 2015).
[63] Paga, 2015: 362.

Paga raises some salient points, but none provide definitive evidence against an archaic date for the Southeast Fountain House. However, her arguments do make the ca. 525 date less certain. Once both the fountain and the Great Drain had been built, the drain supplied and drained the water of the fountain house, but it is difficult to determine which came first. A period of overlapping construction appears possible, as they were both constructed around 500 BCE, both contain polygonal limestone construction [fig. 8a, 8b], and both helped to develop the land of the agora for public use.[64] The Z-clamp cutting would also be more appropriate around this time.

Aside from the difficulties of locating Enneakrounos in the literary record, an issue of size and volume precludes Pausanias' fountain from being the Enneakrounos. The Southeast Fountain House is a long rectangular room made of limestone, 6.80 x 18.20 metres, with three columns along its porch [fig. 5a]. Facing north into the agora, it is located just beside the Panathenaic way where it leads up to the Akropolis. It has two large basins on opposite sides of the room with their respective channels leading into the Great Drain, leaving some space between the two basins for ease of congregation, chatting, and queueing [fig. 5b].[65] It is much bigger than most private wells which were made of timber or brick and mud. However, this fountain house was not of a size to accommodate an impressive nine-spouted wellhead and there is little literary or archaeological evidence to suggest that the Southeast Fountain House was particularly impressive or grand looking. Pausanias gives it only a cursory glance, and the building is rather smaller than we might expect from a tyrannical construction, which tends towards the monumental. Half the building is taken up by the two basins. It was dwarfed by further construction in the agora in the 4th century as well as the construction of the Southwest Fountain

[64] I would like to explore this idea in more depth, but for the purposes of this study, this is still supposition.
[65] Paga, 2015: 359.

House, and by Pausanias' time it was somewhat hidden by other buildings, a further indication of its less-than-grand appearance [fig. 2b].[66] Other references to the Enneakrounos fountain highlight the large volume of water that came from its natural spring.[67] The Southeast Fountain House, however, brought water to the fountain through an aqueduct and if there was a spring at the site, it did not provide much water, hence the need for a pipeline supply.[68]

In the mid 6th century, the archaeological record shows that most of the wells in the quickly developing area of the classical agora were closed, and the Southeast Fountain House was constructed not long after. These were mostly private structures, the closure of which may have necessitated a new public water source in the area as swiftly as possible—perhaps suggesting an earlier date for the fountain—but this could also be an early part of the de-privatization of the space through the second half of the century and into the 5th century. However, the nearby presence of the Kallirhoe spring on the edge of the Pnyx, the potential Enneakrounos on the Ilissos River, and even the Akropolis springs like the Klepsydra, all reduce the necessity of a new fountain house in this area under the tyrant even after the wells were closed. This closure of the private wells and the development of the space of the classical agora has often been interpreted as a result of Peisistratos centralizing his control of the city, since he closed the wells and began building on the edges of the area.[69] It is possible the closure was a sign of the *demos* eking out a new path for their emerging form of government, especially if the fountain house is downdated.[70]

[66] It is likely that by Pausanias' time the Southeast Fountain House no longer even produced any water.
[67] Cf. Owens, 1982: 224.
[68] Owens, 1982: 224.
[69] Osborne, 2007: 196.
[70] Paga, 2015: 362.

Regardless of the authorship of the fountain, after the abolishment of tyranny in Athens, the area became solely democratic, focused on creating a public space for the democracy. The movement of civic buildings and the marketplace in 508/7 BCE, from the archaic agora with its connections to tyranny, into the classical agora with its statue venerating the tyrannicides, would have required a new water source within the area, and would have helped to delegitimize the importance of the old agora. Just as public building works helped tyrants maintain popular support and provided a daily reminder to a visitor of the donor and his family as they retrieved water, in a democracy fountain house were important symbols.[71] Water fountains were social gathering places for news and gossip, as well as necessities in the *polis*. A new fountain house would draw people into the new civic centre and reduce the traffic to the older, tyrant-built fountains and spaces.

A construction date of after 480 BCE could make sense since many more wells around the city (particularly in the old and new agorai) were closed after the Persian sack of Athens, potentially due to pollution by the Persians, which would have created an urgent need for a new water source.[72] If Paga's downdating is accurate, the erection of a public fountain in the new civic centre becomes an expression of the new democracy, one that created public works and spaces and built back stronger after a devastating invasion. This would be in line with the architectural projects around the city in the 5th century, especially the Periklean building program in the latter half of the century. However, the funds allocated to the Periklean program and to rebuilding after the Persian sack were meticulously recorded, and there is no mention of a new fountain house in the agora. The lack of evidence for the allocation of funds is an issue for dating

[71] Theodora Kopestonsky, "The Greek Cult of the Nymphs at Corinth", in *Hesperia*, vol. 85, no. 4 (2016): 720.
[72] Paga, 2015: 377, drawing on T.L. Shear Jr., "The Persian Destruction of Athens: Evidence from Agora Deposits", *Hesperia* 62 (1993).

the Southeast Fountain House. It could be because building accounts were more common for sacred building projects than for civic projects, but it could also suggest a private donor's enterprise, or a tyrant's project.

There are also many important water sources on the Akropolis. The agora sits in a hydrological basin, but all the surrounding hilltops are also capped by limestone, which causes a great amount of runoff to flow down the mountains and collect in the agora. This contributes to the marshy conditions in the agora, but also means that there are many streams on these hills, and since limestone is quite porous, there are substantial stores of groundwater for springs to draw from. The Akropolis Asklepieion [fig. 10, 11] is situated on one of these springs.

The spring marks the spot as a good site for an Asklepieion, as Asklepios and his daughter Hygieia are closely associated with pure water. Inscriptions from the Sanctuaries of Asklepios at Epidauros and in Athens attest to the importance of fresh water in the healing cults of Asklepios and Hygieia. It was necessary to purify oneself before entering a shrine, and water—as indicated by Hippokrates—was an important aspect of health. The spring is located on the south slope of the Akropolis and gushes forth from the rock, so it seems Hippokrates would not wholly approve of this spring, but it was still viable to be used in the worship of the god of medicine. Perhaps the ideas recounted in the treatise were not so prevalent as they appear, or perhaps the medicinal nature of the sacred site negated the health defects of drinking hard, south facing waters. It should also be acknowledged that Hippokrates does prescribe drinking certain waters that he otherwise classifies as bad in order to cure particular aliments, which could have been the case with this Akropolis spring.

The connections between public life, civic life, and private life were present in the methods of worship at the Asklepieion. Asklepieia functioned as public hospitals, available for anyone to

enter, provided they had been purified. Many 4th century BCE votive relief pictures of Asklepios and Hygieia interacting with worshippers have been found at the Akropolis Asklepieion. These fit into a sculptural program found in most Asklepieia, such as those at Peiraeus and Epidauros. They often represent the god whispering into a sleeping patient's ear, explaining the medications that will heal them [fig. 12a, 12b]. This meant that worshippers were expected to personally commune with the god to an extent. The personal cure for the private individual was illuminated through worship at a public hospital.

According to inscriptions found in the area, a man named Telemachos imported the worship of Asklepios to the Akropolis from Epidauros around the 7th or 6th century and was responsible for its initial upkeep. In the mid 4th century BCE, however, the running of the cult passed into the hands of the state.[73] Thus, the temple was initially a product of aristocratic civic building, but even so the intent of the shrine was always for public use since it was built on the Akropolis.

The Athenian Asklepieion—like all temples—exists in a kind of liminal space between public and private. Because of this liminality of temples, the sacred and public spaces of a *polis* must often intersect, which confuses the distinctions that Hippodamos supposedly made in his urban theory. If Aristotle is to be believed about Hippodamos' constitution, then the Greeks must not have considered sacred spaces to be 'public' in the same way that we in the modern day might. Instead, they are a third category, somewhere between public and private because of their association with the state or the ruler, but also with the individual who comes to visit privately.

Two other water sources on the Akropolis can also be examined through a political and Hippokratic lens: the Mycenaean well and the Klepsydra fountain. Both are orientated on the

[73] Camp, 2004: 122.

north slope of the Akropolis, allowing them to fit into Hippokrates' cardinal directions, with very close access points. In contrast to the Southeast Fountain House, the Klepsydra fountain [fig. 9b] is much easier to identify, though it shares a name with the monumental water-clock in the agora. On the northwest slope an underground spring fed into a fountain house probably built by Kimon around 470-460 BCE.[74] According to the Akropolis placard next to the ruins of the fountain house [fig. 9e], the spring had been accessible from Neolithic times, but it was not until Kimon that a proper monumental fountain structure was built [fig. 9d]. It is located near the intersection of two very important streets: the Panathenaic way and the Peripatos road that circles the Akropolis,[75] and was surrounded by cave shrines.[76] These shrines provide mytho-civic connections to the spring. One of the three caves above the spring was the mythical site of Kreusa's rape by Apollo. This event connects the spring to the founding myth of the Ionic people.[77] The identification of a Cave of Pan and a cave dedicated to Zeus marks this area out as sacred, which could help to further explain the continued use of the spring.

Below the Klepsydra, far down the north slope of the Akropolis, there is a well, built around the mid 13th century BCE. This well could be reached by an extensive covered stairway of about four or five flights. Many potsherds from the Late Helladic IIIC period have been found in the well shaft, with some Early and Middle Helladic and even Geometric pottery in the mix of fill higher up the shaft.[78] This was not a natural spring like the Klepsydra fountain but actually a well dug into the groundwater. If the Klepsydra spring was indeed in use from the Neolithic period on, that would indicate that water was not particularly difficult to come by on the

[74] Camp, 2004: 71.
[75] The Hydria Project, "The Spring and the Fountain of Klepsydra: Water Works", on *Hydria Project: Collection, Storage & Distribution of Water in Antiquity Linking Ancient Wisdom to Modern Needs* (2009).
[76] Akropolis information placard: "The Paved Court of Klepsydra." Cf. fig. 9e.
[77] As described in Euripides' *Ion*.
[78] Oscar Broneer, "A Mycenaean Fountain on the Athenian Acropolis", in *Hesperia*, vol. 8, no. 4, (1939): 349.

Akropolis. The several other wells nearby outside the protective shaft from the classical period also suggest this.[79] The Mycenaean well seems to have fallen out of use around the turn of the 12th century BCE, though the few sherds from later periods means that it was likely still somewhat accessible.

The biggest challenge to water on the Akropolis, however, comes in the form of crumbling soil. While there is a large amount of firm limestone on the hill, it is based atop softer, clay-rich soil and rock, which presents great challenges to the structural integrity of any deep, cave-like structure on the Akropolis.[80] The Klepsydra fountain was frequently beset by blockages from falling limestone as the rock and soil beneath it crumbled [fig. 9a], and the builders of the Mycenaean well shaft had to use wooden beams to support stone and wood flights of stairs where it was too soft to carve steps into the rock.

It is tempting to suggest that Kimon's Klepsydra fountain house was the successor to the Mycenaean well, establishing a new, public fountain directly above the old, inaccessible well associated with Mycenaean kingship. However, Klepsydra was a naturally occurring spring and a fountain house to augment and control the flow of water—as well as reinforcing the crumbling limestone around the spring—would have been a logical step. Despite this logical explanation, the fountain house is still associated with Kimon, which puts its construction within a period of democratic building works. Though Kimon himself leaned somewhat anti-democratic, the fountain house must be classified as a democratic building project by virtue of being constructed under the democracy. It was accessible from the Panathenaic Way and from the Akropolis summit, two areas in Athenian city life that were inherently public. There are obvious democratic

[79] Broneer, 1939: 422, fn.174.
[80] Broneer, 1939: 343. Broneer treats the challenges of building a protective stair shaft into the Akropolis rock with models and reconstructions on pages 326-346.

implications of the Klepsydra fountain house including Kimon's role in its construction, its easy accessibility, its location on a public site of worship and along the route of the Panathenaia, and even from mythical connotations of civic duty and rights, but not from any contrast to the Mycenaean well. The well, however, presents a fear of siege and invasion. The Mycenaean structure on the Akropolis summit required a water source accessible from within the fortress walls, and it seems the Klepsydra spring was too easily accessible and so was unprotected. This well provided water to residents of the structure, and so must be considered a private-use building project.

Perhaps a democratic consideration played a part in the Klepsydra fountain house design in the 5th century, but it could not have been the only concern. The spring was in use for centuries, and regardless of tyrannical and democratic agendas, water is a necessity. It seems more likely that the abundance of water on this side of the Akropolis slopes—due to the structure of the hydrologic basin of the agora below—encouraged the construction of various modes of exploiting that abundance.

Water resources were clearly a consideration in Greek urban and health planning, and how these considerations intersect with changing governmental structures and the construction of necessary infrastructure is an important and relatively unexplored area of study. Athens has the greatest written record, with incredible resources for the study of water management in antiquity, but considerations for water supply were a crucial part of the design and operation of all *poleis*. In Athens, water was considered the responsibility of the *demos*, to such a degree that the office of 'water commissioner' (similar to Frontinus) was an important elected position. "Already in

Greek times, the community had recognized the necessity of working together and spending common funds on water supply and drainage for the benefit of all."[81]

The second chapter of this thesis consists of two case studies, Akragas and Metaponto, Greek colonies in Italy, which show overwhelming evidence of deliberate settlement design in their urban plans and water systems. The case studies demonstrate that water management was integral urban infrastructure as important as street alignment or land division. The ancient theories presented in this first chapter are challenged by Akragas and Metaponto (as well as Athens), but these cities were not outliers, rather, provisions for practical water management based on a site's specific hydrogeomorphology are seen throughout the ancient world.

This discussion of Athens establishes that management of water consumption preoccupied the *demos*, while the case studies of Akragas and Metaponto illustrate that water management was necessary for reclamation of land and agricultural viability to make settlements possible. The final chapter of this thesis presents my conclusions and further questions for a longer dissertation. This thesis deals with broad issues in the ancient world that needed both specific and general solutions on a vast scale. Citywide water supply issues were addressed by the whole citizenry but required individual participation, regardless of the regime in charge of the *polis*. Tyrannical cities, democracies, and every governmental structure in between engaged in collective water management for the common good.

[81] Crouch, 1993: 31.

Chapter 2
Case Studies: Akragas and Metaponto

This chapter examines the material and textual evidence for city planning and water systems at Metaponto in Magna Graecia and Akragas in Sicily. The water systems at these cities indicate intentional urban and rural planning in Greek colonies. Though there is a gap of roughly fifty years between the establishment of Metaponto in 630 BCE, and the foundation of Akragas in 582 BCE, they have similar features that encourage an examination of the two *poleis* together. Metaponto was founded by Achaean settlers and Akragas was founded by colonists from Gela, with the help of settlers from Rhodes and Crete. Both cities had a series of tyrants, and both had brief periods of democratic rule after the fall of powerful tyrants in the early classical period. Metaponto and Akragas are situated within karst basins, which allowed for extensive natural waterways and water-innovation. They are both coastal colonies that show deliberate evidence of having been carefully planned with a grid or orthogonal street plan.

Any urban plan must take into account the geological and hydrogeological phenomena of its site. In her crucial studies on the geology of the ancient world, Dora Crouch notes that "geology … controlled the resurgence and abundance of water, of soils suitable for agriculture and forestry, of building materials, and the location and type of transportation facilities such as ports and roads."[82] Thus, considering the geology of a space is one of the most important concerns in the siting and designing of cities. Many cities in the ancient Mediterranean—including Athens, Korinth, Rhodes, Morgantina, and Rome—are situated in areas with a high level of karst activity: an hydrological phenomenon wherein an area with a base layer of carbonate rock—usually limestone—forms tunnels and solution channels in the rock through

[82] Dora Crouch, *Geology and Settlement: Greco-Roman Patterns* (USA: Oxford University Press, 2003): 21-22.

chemical weathering, which allows water to easily move through it.[83] Limestone ranges from very hard to very soft, but, regardless, it is soluble and so is often very porous, which makes it an excellent conduit for water. Karst activity is found all over Greece, including the Peloponnesos and even in the northern part of Crete, but it is also found in Italy, particularly in the south, and in Sicily.[84] Despite the Mediterranean region's reputation for dry, rocky terrain, this abundance of karst activity suggests that there was a plethora of potential city sites with adequate water sources for both the *asty* and the *chora*.

At Akragas, the carbonate rocks of the karst are primarily calcarenite, a type of limestone that is dense but still porous, owing to it being composed of more than 50% sand-sized carbonate grains, making it grainy and rather coarse.[85] The coarseness of the calcarenite at Akragas means the stone is highly porous so that water seeps into it and causes it to split easily, allowing water to flow in channels along the impenetrable clay and marl units at the top of the water table.[86] The water system found at Akragas is similar to the one found on Rhodes, where the builders cut channels in the karst, down to the clay and marl units below to reach the line of seepage—the 'phreatic line'—the midpoint at which all below is governed by hydrostatic pressure and all above is governed by atmospheric pressure.[87] This midpoint often coincides with the water table, along which water moves very easily. Akragas' porous limestone combined with the high clay content in the soil and uneven bedrock, creates "many restricted and suspended water tables" that feed the many springs and wells in the city.[88] The water carves paths through the limestone as it travels along the "water tables" that make up the karst system. The people of modern Agrigento

[83] Crouch, 2003: 25.
[84] Crouch, 1993: 64.
[85] Crouch, 2003: 27-28.
[86] Crouch, 1993: 96.
[87] Crouch, 2003: 27.
[88] Crouch, 2003: 30.

refer to this extensive system of underground cavities beneath the city in the Girgenti hill as the *ipogeo*. '*Ipogeo,*' from the Greek *hypogaion/hypogeion* means "underground" or "subterraneous." This includes aqueducts, underground streams, reservoirs, catacombs, cisterns, and the Ipogeo del Purgatorio, a labyrinthine system of channels, catacombs, and cisterns that was also used as a quarry.[89]

Metaponto is located in an area with a significant limestone sublayer and clay-heavy soil that both contribute to a water-rich site and are necessary for karst phenomena to occur. It is in a low, marshy valley, with rocky hills surrounding the site.[90] Because of the abundance of rich clay and water in the ground, even with the severe rate of erosion in the Metapontine, the soil has always been suitable for agriculture, though it is prone to flooding [fig. 20b].[91] The presence of limestone, clay, swamp conditions, and hills, suggest that Metaponto is located within a karst basin, like Athens and Akragas. There are other karst sites nearby in the "heel" of Italy, so we can tentatively assume that there was karst activity at Metaponto as well.

The marshy *chora* required drainage, while the agora frequently flooded.[92] Metaponto engaged in systematic drainage in its *chora*, through extensive *bonificia integrale* that "consists of land reclamation through drainage and its distribution or redistribution to settlers."[93] The

[89] Karst channels were used as aqueducts and cisterns in the classical and Hellenistic periods and then in early Christian times they were also often used as catacomb burials (Crouch, 1993: 211). Many cities in southern Italy still give tours of their *ipogeo* tombs, like Naples.
[90] Cf. Robert Folk "Geologic Background of the Metapontino," and James Abbott "Geomorphology and Geoarchaeology of the Metapontino," in *The* Chora *of Metaponto 3: Archaeological Field Survey Bradano to Basento*, eds. Joseph Coleman Carter and Alberto Prieto (Austin: University of Texas Press, 2011).
[91] Abbott, 2011: 64.
[92] Even in just the last two decades, the ancient city centre has flooded twice, once in 2007, and more recently in 2014.
[93] Joseph Coleman Carter, "Controlling Water, Dividing Land: Ancient Bonifica at Metaponto," in *Opere di Regimentazione delle Acque in Etá Arcaica: Roma, Grecia e Magna Grecia, Etruria e Mondo Italico*, ed. Elisabetta Bianchi and Matteo D'Acunto (Rome: Edizioni Quasar di Severino Tognon, 2020): 238. I will only be talking about *bonificia* in the context of Metaponto, but it is interesting to note that allegedly an early tyrant of Akragas enacted one of the earliest examples of *bonificia:* "The earliest recorded example is that of Aristodemos, tyrant of Kyme in the late 6th century BC, followed by Empedokles of Akragas, who was credited with two bonifiche. The first was in his native city, where he reportedly tamed the winds and returned the fields to productivity. The other was Selinous,

countryside surrounding the city of Metaponto is very fertile owing to this karst activity, and this was controlled by the addition of a system of canals crossing many of the division lines in the *chora,* which augmented the amount of water available to the fields, and drained the swampy area of the countryside. This system of *bonificia integrale* forms a grid over two main sections of the *chora*, which are separated by the Basento River. The orthogonal *chora* plan is in line with the grid in the agora and the residential urban plan, and there is some overlap of the hydrogeological formations in the area with the anthropic water channels of the *chora* and *asty*. Similarly, in Akragas, the humanmade waterways often made use of the natural hydrogeomorphology, as is particularly evident in the construction of the *kolymbethra*.

Akragas

Colonists from Gela, a colony of Rhodes, founded Akragas in 582 BCE. Unlike earlier, mainland Greek cities that grew organically, sprawling out as the population increased through the centuries, Akragas "shows evidence of conscious planning from the beginning."[94] The water system found at Akragas is similar to the one found on Rhodes, where the builders cut channels in the karst to reach the water table.[95]

The ancient city of Akragas was located in a natural basin surrounded by a series of hills and ridges. The modern city of Agrigento is now situated on top of one of these hills, the Girgenti hill, along the northern ridge. This hill has the foundations of two ancient temples on it but also an *ipogeo* under the city. The natural basin of the site came to a low point in the southwest corner and was probably the site of the agora and the *kolymbethra*, an artificial pond

where he is supposed to have brought two rivers together and eliminated pestilential conditions, a service for which he was honored as a god." Carter, 2020: 203 (Diogenes Laertius, *Lives and Opinions of Eminent Philosophers,* 8.72).

[94] Burns, 1974: 397.

[95] Crouch, 2003: 27.

that collected the overflow of the city's aqueducts and natural run-off.[96] It is now a lush garden park within the archaeological tourist attraction, the Valley of the Temples [fig. 14a, 14b, 15].

Polybius' definitive description of the city highlights the connections between its geology and its design:

> "The city of Akragas excels most cities… in the strength and, above all, the beauty of its site and buildings. It was founded at a distance of eighteen stades [app. 2 miles] from the sea so as to enjoy all the advantages of a port city. Its perimeter is secured by natural and artificial defenses of outstanding strength. Its wall rests on cliffs, either sheer by nature or cut off vertically by hand. Akragas is surrounded by rivers; the river of the same name flows along the southern flank, the one called Hypsas follows the west and southwest sides. The acropolis overlooks the city from the east, its outer face bounded by an impassable ravine, its inside accessible only by a single approach from the city."[97]

Polybius cites the splendour of the site and the buildings of Akragas as reasons for why it "excels most cities." But his description also makes clear how the natural, geological environment contributed to the beauty and strength of the city. Its defenses are based on the ring of ridges surrounding the basin-like city centre, which is well-watered, with two rivers flowing around it, and extensive karst channels and aqueducts.

In some cases, the natural defenses of the ridges [fig. 14a] were altered to form a sheer drop facing out from the city, so that the natural fortifications were shorn up by manmade ones, as described in Polybius. These fortification alterations are concurrent with the founding of the city and create a large, impregnable fortress. Alfred Burns points out that, at this time, it is

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[96] Burns, 1974: 399.

[97] Polybius, *Histories,* 9.27: ἡ δὲ τῶν Ἀκραγαντίνων πόλις οὐ μόνον κατὰ τὰ προειρημένα διαφέρει τῶν πλείστων πόλεων, ἀλλὰ καὶ κατὰ τὴν ὀχυρότητα, καὶ μάλιστα κατὰ τὸ κάλλος καὶ τὴν κατασκευήν. ἔκτισται μὲν γὰρ ἀπὸ θαλάττης ἐν ὀκτωκαίδεκα σταδίοις ὥστε μηδενὸς ἀμοίρους εἶναι τῶν ἐκ ταύτης χρησίμων: ὁ δὲ περίβολος αὐτῆς καὶ φύσει καὶ κατασκευῇ διαφερόντως ἠσφάλισται. κεῖται γὰρ τὸ τεῖχος ἐπὶ πέτρας ἀκροτόμου καὶ περιρρῶγος, ἣ μὲν αὐτοφυοῦς, ἣ δὲ χειροποιήτου, περιέχεται δὲ ποταμοῖς: ῥεῖ γὰρ αὐτῆς παρὰ μὲν τὴν νότιον πλευρὰν ὁ συνώνυμος τῇ πόλει, παρὰ δὲ τὴν ἐπὶ τὰς δύσεις καὶ τὸν λίβα τετραμμένην ὁ προσαγορευόμενος Ὕψας.ἡ δ᾽ ἄκρα τῆς πόλεως ὑπέρκειται κατ᾽αὐτὰς τὰς θερινὰς ἀνατολάς, κατὰ μὲν τὴν ἔξωθεν ἐπιφάνειαν ἀπροσίτῳ φάραγγι περιεχομένη, κατὰ δὲ τὴν ἐντὸς μίαν ἔχουσα πρόσοδον ἐκ τῆς πόλεως. Sourced from Perseus Tufts. Trans. W.R. Paton in Burns, 1974: 397-398.

unlikely that more than 10,000 inhabitants lived in Akragas, but with Diodorus Siculus recording a population of 200,000 by the late 5th century, it seems the city fortifications at least were designed with a larger population in mind.[98] The orthogonal street plan of Akragas was also built during the founding of the city, which provides the most obvious evidence of urban planning at the site.

In *Olympian 3*, Pindar praises Theron, the early 5th century tyrant of Akragas, for winning the chariot race in 476 BCE. At the end of the poem, he praises Theron with a simile comparing him to water and gold. "If water is best and gold is most honoured of all possessions, so now Theron reaches the farthest point by his own natural excellence; he touches the pillars of Herakles."[99] These lines recall *Olympian 1*, written for the tyrant of Syrakuse, in which Pindar writes that "water is best, and gold, like a blazing fire in the night, stands out supreme of all lordly wealth."[100] Twice, Pindar pairs water with gold, a valuable metal, and both times it is in praise of a Sicilian tyrant. Many scholars have tried to puzzle out the statement "water is best," since Pindar leaves it unqualified, unlike gold, which is recognized as the most valuable possession.[101] The implication seems to be that water is the best of the other elements, or even the best thing in nature, like gold is the best of all possessions. However, trying to discover whatever it is that water is best of distracts from the rhetorical device that Pindar is using in these poems. The poet uses an ascending tricolon—wherein three parallel words, clauses, or sentences

[98] Burns, 1974: 399-400.
[99] Pind.*O*.3.42-44: εἰ δ' ἀριστεύει μὲν ὕδωρ, κτεάνων δὲ χρυσὸς αἰδοιέστατος, νῦν δὲ πρὸς ἐσχατιὰν Θήρων ἀρεταῖσιν ἱκάνων ἅπτεται οἴκοθεν Ἡρακλέος σταλᾶν. Sourced from Perseus Tufts. Trans. by Diane Arnson Svarlien (1990).
[100] Pind.*O*.1. 1-2: ἄριστον μὲν ὕδωρ, ὁ δὲ χρυσὸς αἰθόμενον πῦρ ἅτε διαπρέπει νυκτὶ μεγάνορος ἔξοχα πλούτου. Sourced from Perseus Tufts. Trans. by Diane Arnson Svarlien (1990).
[101] Cf. William Race, "Pindar's 'Best is Water:' Best of What?" in *Greek, Roman, and Byzantine Studies*, vol. 22, is. 2 (USA: Duke University Press, 1981); Pär Sandin, "The Emblems of Excellence in Pindar's First and Third Olympian Odes and Bacchylides' Third Epinician," in *Lexis: Poetica, Retorica e Comunicazione nella Tradizione Classica,* ed. Adolf M. Hakkert (Venice: Vittorio Citti, 2014).

gradually increase in length and complexity to elevate the drama and importance of the text—to emphasize the great praise he is laying on his tyrant-subjects in each poem. Water is not the focus of the tricolons, but nor can it be ignored since it is the subject of the first clause in both. Pindar expects his audience to understand implicitly what water is best of, so that he can swiftly move on to the next part of the tricolon. Water is necessary for sustaining life and given the theories of and medicinal and ritual importance of different waters, Pindar's assertion that water is best first in the tricolon illustrates that even outside the study of natural physics in antiquity, water was recognized to be vital. The role water plays in *Olympian 3* is made more even more important by the extensive waterworks that Theron appears to have presided over, culminating in the *kolymbethra*.[102] Water is a relevant simile in the poem because of the very real water management efforts connected with Theron.

Akragas is somewhat unique in the Greek world because of its public leisure pool, the *kolymbethra* [fig. 15]. Commissioned by Theron after the defeat of the Carthaginians in the Battle of Himera in 480 BCE, its design is attributed to both Theron and Phaiax—a potentially apocryphal figure associated with water management efforts in Akragas.[103] Diodorus Siculus provides a description of the pool in its heyday, before describing its decline.

> "The [Akragantines] also built an expensive *kolymbethra*, seven *stades* in circumference and twenty cubits deep. Into it the waters from rivers and springs were conducted and it became a fish-pond, which supplied fish in great abundance to be used for food and to please the palate; and since swans also in the greatest numbers settled down upon it, the pool came to be a delight to look upon."[104]

[102] Crouch, 1993: 49-50.
[103] Crouch, 1993: 208. Diodorus Siculus, *Historical Library,* 11.25.3: ἐπιστάτης δὲ γενόμενος τούτων τῶν ἔργων ὁ προσαγορευόμενος Φαίαξ διὰ τὴν δόξαν τοῦ κατασκευάσματος ἐποίησεν ἀφ᾽ ἑαυτοῦ κληθῆναι τοὺς ὑπονόμους φαίακας. It is not clear in the text if Theron envisioned the waterworks projects and then Phaiax made them reality, or if Phaiax was the great genius of the Akragantine waterways. Sourced from Perseus Tufts.
[104] Diod.11.25.4: κατεσκεύασαν δὲ οἱ Ἀκραγαντῖνοι καὶ κολυμβήθραν πολυτελῆ, τὴν περίμετρον ἔχουσαν σταδίων ἑπτά, τὸ δὲ βάθος πηχῶν εἴκοσι. εἰς δὲ ταύτην ἐπαγομένων ποταμίων καὶ κρηναίων ὑδάτων ἰχθυοτροφεῖον ἐγένετο, πολλοὺς παρεχόμενον ἰχθῦς εἰς τροφὴνκαὶ ἀπόλαυσιν: κύκνων τε πλείστων εἰς αὐτὴν καταπταμένων

Despite the neglect it suffered in later years, the area that had been the site of the *kolymbethra* was, and still is [fig. 19b], extraordinarily fertile because it is a natural run-off site. Diodorus describes a beautiful and fruitful garden that sprang up there after the *polis* no longer maintained the *kolymbethra*.

According to Aristotle's account of Hippodamos' urban theory, the city should be divided between the sacred, temples and the like; the public, civic buildings, the agora, water fountains; and the private, or residential. The orthogonal city plan separates the sacred from the public and both the sacred and the public from the private. The division of land at Akragas fits neatly into these categories. The residential and civic *asty* is at the centre of a radiating unit with a 'belt' of temples on the ridges around the basin of the town. In the city centre, the civic and residential buildings are separated, with the agora near Gate V and the *kolymbethra* [fig. 16], and the residences laid out in an orthogonal grid plan [fig. 17a]. The walls circle around the city and temples, making use of the natural defenses of the steep ridges, and the necropolis is outside the city in the west *chora*. This tripartite division of the Akragas *polis* aligns well with Aristotle and Hippodamos, but general scholarly consensus has long identified Akragas as a 'sacred belt' design rather than a 'Hippodamian' or solely orthogonal plan. The 'sacred belt' plan is a city layout that places sanctuaries and temples in a ring around the residential and public centre of the city.[105] However, these two urban plans are not incompatible and in Akragas seem to have merged to great effect.

συνέβη τὴν πρόσοψιν αὐτῆς ἐπιτερπῆ γενέσθαι. Trans. by C. H. Oldfather. Sourced from Perseus Tufts. Cf. Burns, 1974: 400.

[105] Spencer Pope, "Urbanization in inland Sicily: Acculturation on the periphery of the Greek world," in *Ancient Urban Planning in the Mediterranean: New Research Directions*, ed. Samantha Martin-McAuliffe, Daniel Millette (USA: Routledge, 2018). Emanuele Greco, "Sanctuaries of Magna Graecia and Sicily," in *Magna Graecia: Greek Art from South Italy and Sicily*, ed. Michael Bennett, Aaron Paul, and Mario Iozzo (New York: Hudson Hills Press, 2002): 112. Fausto Longo, "From Sybaritic *Teichos* to Poseidonia. Reflections on the Origins and Early Decades in the Life of an Achaean *Apoikia*," in *Annvario della Scuola Archeologica di Atene e delle Missioni Italiane in*

Because of its strategic built-up fortifications, with temples lining many of the ridges and towering over the city proper, an artificial pond, and the orthogonal plan of the city streets, it seems that Akragas was planned very deliberately, and intended to be a consequential and spectacular city. Diogenes Laertius attributes this quote to Empedocles: "The [Akragantines] live delicately as if tomorrow they would die, but they build their houses well as if they thought they would live forever."[106] The houses themselves may not have lived forever, but the evident care they took in designing their city certainly has

Metaponto

At Metaponto, a system of water management extended across a portion of the *chora*, and functioned to drain the marshy area, making it arable. They established a system of *bonificia integrale*, freeing up the land of the *chora* for distribution among its citizens, nearly concurrently with the founding of the city in the late 7th century BCE. This *bonficia* involved division lines laid out in a grid across the *chora* [fig. 18a, 18b], but also utilized necropoleis and canals to delineate the rectangular plots [fig. 20a].[107] Drainage was not always the main purpose of water management in the *chora*, since there were several environmental fluctuations which saw the area dry out and then become marshy again, water also needed to be stored and directed throughout the landscape.

The water table in the Metaponto *asty* rose in the 6th and 5th centuries and then the sea level rapidly rose around 500 BCE and 200 BCE, occurrences that contributed to the amount of water

Oriente, supplement 3, ed. Emanuele Greco and Athanasios Rizakis (Italy: Scuola Archaeologica Italiana di Atene, 2019): 10-11.

[106] Diog. Laer. 8.63: Ἀκραγαντῖνοι τρυφῶσι μὲν ὡς αὔριον ἀποθανούμενοι, οἰκίας δὲ κατασκευάζονται ὡς πάντα τὸν χρόνον βιωσόμενοι. Sourced from Perseus Tufts.

[107] Christine Davidson has also done extensive work on these division lines, exploring how they could be used as roads. Cf. C. Davidson, "Connectivity and Land Division in the *Chora* of Ancient Metaponto: an investigation using Geographic Information Systems" (Canada: Unpublished dissertation at McMaster University, 2022).

and the frequency of flooding in the whole Metapontine and caused depopulation in the town.[108] In contrast, in Athens, the strain of rapid population growth caused the water table to lower dramatically in the 4th century BCE. The different water conditions in Athens and Metaponto called for different water solutions. The large public fountains in Athens were reliable water sources with a large yield and were less work to build and maintain than private wells, which would dilute the concentration of water on the water table and yield less. Metaponto, on the other hand—with so much marshland and water close to the surface—built large canals, so that in the fields, and even within the *asty*, there was always water close to hand.[109]

The abundance of water created a drainage problem, which the canals helped to fix by redirecting the bulk of the water to where it was needed, rather than just leaving it to sit along the water table and in marshy pools around the *chora* and *asty.* Most of the canal system and division lines closely followed the natural drainage channels in the ground. These natural channels were not significant enough to support the settlement alone, and needed to be enhanced, but they are very neatly perpendicularly aligned. They follow a "deep-seated fracture system which imposes a strong northwest-southeast grain on the surface topograph[y]", with downslope streams "in an orientation perpendicular to" concretions in the Pleistocene shorelines [fig. 19b].[110]

There are two distinct sets of orthogonal division lines in the countryside around Metaponto. The earlier set is located in the Bradano-Basento watershed, and the later one (oriented at an angle away from the first) is in the Basento-Cavone watershed [fig. 18a]. The

[108] Folk, 2011: 12. Joseph Coleman Carter, *Discovering the Greek Countryside at Metaponto*, Thomas Spencer Jerome Lectures (USA: University of Michigan Press, 2006): 218.
[109] This does not mean there were not fountains in the *asty*, only that the need for them was diminished by the extensive canal system.
[110] Folk, 2011: 12.

division and canal lines in the older, Bradano-Basento section of the *chora* were established at the time of the foundation of the city and were part of the initial planning stages. During survey and excavation from 1999-2002 in preparation for the SNAM pipeline—that transects one of the densest areas of the built environment in the Bradano-Basento watershed—archaeologists discovered that these division lines were crossed by a series of canals.[111]

Along these division lines, many burial sites have been found as a sort of extra demarcation of the property lines and along one of these lines in particular is the site of the Pantanello necropolis, where one of the first canals was discovered perpendicular to the division lines.[112] Many of the canals are flanked by burials with stone sarcophagi or cist tombs.[113] Necropoleis near the division lines and canals emphasize their role in dividing the *chora*, because "burials were a very visible way of claiming ownership of land."[114] This suggests that the canals were also important for the division of property, though their main purpose must have been to drain and to irrigate the *chora*. Some of the canals contain fill with pottery dating back to the mid 5th century, and these canals continued to function possibly as late as the 3rdC BCE. The remnants of pollen and many flora samples found in humid environments in the fill indicate a changing environment from the mid 5th century into the 3rd, an environment that was often damp and somewhat marshy, with dry spells before humidity levels rose again.[115] Few aquatic plant remains have been found, however, which, Joseph Carter suggests, means that the canals were "periodically cleaned and kept free of plants that could block [the] flow."[116]

[111] Carter, 2020: 213-214.
[112] Carter, 2020: 216.
[113] Carter, 2020: 213.
[114] Carter, 2020: 216.
[115] Carter, 2020: 214.
[116] Carter, 2020: 214.

Several sections of the perpendicular canals seem to have been built in order to drain the *chora*, and the presence of short, diagonal, 'feeder', channels [fig. 23] (containing similar fill to the canals) supports this idea. Carter points out that the environmental evidence does not seem to necessitate such an extensive undertaking, since the *chora* was never a swamp.[117] Erosion is a major issue in the modern Metapontine, and likely presented a further challenge to the ancient settlers. It is possible that erosion and flooding, particularly during the rainy winter season, may have contributed to the necessity of widescale water management, which then led to the development of more sophisticated irrigation techniques.[118]

The urban centre of Metaponto, the *asty*, also contains an orthogonal city plan [fig. 21], with the residential grid separate from the various temples inside the city on their own somewhat regular grid plan, with both grids mostly perpendicular and continuous with the other.[119] The *asty* is divided by large roads called *plateiai*, and crossed by smaller roads, *stenopoi*, and canals [fig. 22]. The plan of the *asty* was probably mostly built in the mid 6th century BCE, but its antecedent is illustrated through the grid in the *chora* and it existed in a smaller iteration from almost the founding of the *polis*.[120] It seems that the grid streets of the residential area and the agora, especially the main *plateia* running north-south in the *asty*, *Plateia* A, influenced the orientation of temples built in the late 6th century, since the archaeological record shows a shifted axis in the rebuilding process of temples A2 and B2 [fig. 21].[121] Ultimately, this means that the *chora* influenced the orientation of the temples, since the *asty*—built after the division lines in the

[117] Carter, 2020: 216.
[118] Jens Krasilnikoff, "Irrigation as Innovation in Ancient Greek Agriculture," in *World Archaeology*, vol. 42, no. 1 (USA: Taylor & Francis Group, 2010): 117-118. Krasilnikoff suggests that this process occurred in Gortyn, Herakleia, and Kopais, as well as Metaponto.
[119] Ferdinando Castagnoli, "Appendix (1970)," in *MIT Press Open Architecture and Urban Studies: Orthogonal Planning in Antiquity* (Mass.: MIT Press, 2021): 6.
[120] Carter, 2006: 201.
[121] Carter, 2006: 200-201.

chora—is oriented to the division lines [fig. 19a]. Like at Akragas, the orthogonal plan of the residential area was built for a much larger population than occupied the contemporaneous settlement, suggesting deliberate planning for the city's future.

The *chora* lines and the *asty* plan are roughly oriented along the same axis [fig. 19a]. The canals of the *chora* and the drainage passages of the *asty* are then also in line with the natural drainage and water channels in the hydrological basin of the site.[122] The division lines run northwest to southeast, following the natural slope of the plain, which inevitably draws water down towards the *asty* and the coast [fig. 19b]. This also accounts for the slight difference in the degree of the grid in the Bradano-Basento lines from the Basento-Cavone lines since they each "follow in the most economical and direct way the different slopes of land in the two interfluves."[123]

[122] Folk, 2011: 17.
[123] Carter, 2020: 205.

Chapter 3
Conclusions

Water management in the ancient *polis* could be part of a tyrant's building program or under the purview of the public at various places and times throughout antiquity. But whether it was constructed as a private affair or in the public interest, it was always of the utmost importance and consideration. Many cities in the ancient world changed how they made provisions for water management as their governments changed and as their growing populations created increasing demands for new water solutions. The inclusion of considerations for major water systems at and near the foundation of Akragas and Metaponto illustrates that an orthogonal urban plan was not just a layout of straight streets, but a comprehensive, total plan for a living and expanding city. A city that has provisions for water and population growth, connecting water supply to the *demos* through underground networks, with attention paid to and knowledge of the natural hydrogeology.

One of the most significant areas for exploration is the relationship of public works projects to the rule of tyrants in the Greek world. This intersection of civic and political interests may be best exemplified by Athens, which saw the introduction of drains and fountain houses interrelated to the development of broader public spaces, including the agora under the burgeoning democracy. However, this effort towards fair-use public spaces does not preclude tyrannical efforts towards providing for the *polis*. Structures such as the Southeast Fountain House have been attributed to both tyrannical powers and to the democracy.[124] Is this fountain the last gasp of a tyrant on his way out? Or an expression of public-minded design from the developing democracy? Paga's work creates significant doubt for this first interpretation. Though we should be careful about the assumption that the Southeast Fountain House was built by

[124] For further discussion see Paga (2015).

Peisistratos, there are still significant examples of tyrannical building projects around water systems, like the *kolymbethra* at Akragas and the division lines and canals at Metaponto, which were used for centuries through changing governments.

In archaic Athens, public works were almost entirely undertaken by tyrants. Tyrants engaged the public and contributed to "the growth of civic consciousness" during their regimes through building programs, and the establishment of festivals and cults.[125] Monumental building projects have long been the hallmark of tyrants and all the Athenian tyrants left their mark on the city in some way or another, with most of the archons through the classical period following suit. The Panathenaia was expanded and embellished by Peisistratos, which helped create an Athenian civic identity, while the extensive building projects undertaken by Peisistratos and his sons contributed to the creation of public space.

Many fountains and other public works can be reliably attributed to a specific tyrant in Athenian history, but it is less obvious how these public monuments were understood and used once tyranny was abolished and democracy established. It is clear that there was a movement away from buildings and spaces associated with tyrant-rulers in the developing democracy, but this is not reflected in the water systems.[126] This distancing probably encouraged the development of the area that would become the classical agora, since it was relatively undeveloped, aside from the few structures the Peisistratid tyrants had already built in the area. The tyrannical method of appealing to the populace through public buildings appears to have informed how Athenian democratic governments created new public spaces.

[125] Greg Anderson, "Before *Turannoi* were Tyrants: Rethinking a Chapter of Early Greek History", in *Classical Antiquity*, vol. 24, no. 2 (2005): 175, fn.4.
[126] Cf. Osborne (2007).

The argument for downdating the Southeast Fountain House is convincing. Perhaps not as far as Paga's suggested dates, since many of the conditions that could have created a need for a new fountain house in the area of the agora were true before the Persian sack, her pottery evidence is circumstantial, and the architectural evidence is less than certain. It seems more likely that as the agora grew in importance and was given a proper drainage system around 500 BCE, the burgeoning democracy saw the necessity of constructing a secure and clean source of water right in the new agora. The extensive pipeline system that brought water from the Ilissos River on Mount Hymettos to the fountain house shows a very "deliberate attempt to develop the area for public use," according to Camp.[127] The construction of these public waterworks supported the expanded role of public works under the management of the state. If we are to accept a post-Peisistratid date for the Southeast Fountain House, a date around the last years of the 6th century or the very early years of the 5th century seems to fit the historical moment and archaeological record best.

Despite the amount of research and scholarship that discusses this building, there is no firm answer for its authorship, its date of construction, or even its name. Regardless, the decision to build a public water fountain does require the acknowledgement of the necessity of access to water. The increased reliance of the *demos* on this fountain after the closure of the private wells in the area suggests that water was an important public service within the *asty*. This aspect of the private (the wells) being replaced with the public (the fountain and agora) also illustrates how the latter was valued over the former, since the number of private wells decreased dramatically and did not see a resurgence in antiquity. The *polis* and all its services became a public, democratic

[127] Camp, 2004: 35.

space as a whole, not one under the purview of and in service of a tyrant, but one that provided essential services to its people.[128]

In a democracy, the private citizen has a responsibility to maintain and use public spaces and services. Within public-minded building projects, there were significant expectations of private engagement and maintenance. For example, the construction of the Great Drain ca. 500 BCE appears to have been a fully democratic building project, since it was undertaken after the tyrannicide and exile of the Peisistratids, and it aided the development of the classical agora, the democratic civic centre. The state retained primary control over the building and maintenance of the main channels of the drain, but it also required private citizens to ensure and maintain their houses' connection to the drainage system. Many of the small input ducts are built in completely different styles from their neighbours, because each private residence in the area had to hook their toilet up to the system with their own drain channels.[129] This illustrates how democratic building projects relied on individual participation and how individual style and practicality could interact with these projects. The Great Drain allowed the Athenians to create a viable public space for civic and commercial enterprises, but also one that required the explicit participation of private citizens, much like Athenian democracy itself.

For Aristotle, the successful *polis* is one that provides its citizens with the good life (i.e. happiness) and makes them good and just, but it is also one in which citizens are equal and participate in turn in governance. Andrew Lintott points out that Aristotle acknowledges that these are key tenets of democracy, and so Aristotle must be tacitly approving of a certain kind of

[128] Cf. Loren King, "Henri Lefebvre and the Right to the City," in *The Routledge Handbook of Philosophy of the City,* ed. Sharon Meagher, Samantha Noll, and Joseph Biehl (UK: Routeldge, 2020): "whatever a right to the city is, it is best understood in terms of how we use urban spaces, not the market value of those spaces. To put the point another way: the right to the city stands opposed to property rights over urban space" (76).
[129] Yannopoulos et al. (2017): 168.

democracy, despite his reputation as a critic of it.[130] Though Aristotle dislikes democracy as a way of class advancement, he does grant that it is a good system in Athens for achieving the greatest good for the most people, since many men can make wiser and better decisions than just a few good men.[131] This is possible because a mass group will seek to do the best for the most men not only for the few. The Aristotelian city is a community, that works together in order to pursue a good life for all its citizens, and access to clean water and maintained public spaces and services is an important part of accomplishing this goal. A democracy—where every decision about the city is made by the citizens as a collective—is best suited to this kind of *polis*.

The physical space of democracy was reinforced through the construction of and public access to fountain houses, drains, and other waterways. Under a democracy, public space requires constant reaffirmation of a shared social contract, a desire to maintain and use it. This is evident in the construction and maintenance of the Great Drain in the Athenian agora, which required the active participation of private homeowners in order to properly function but was still a state-regulated public service. The Drain played a large role in the development of the agora as a useable public space, home to most of the civic buildings of the new system of government, thereby ensuring its connection to democracy. A movement away from buildings constructed by the Athenian tyrants facilitated the development of the classical agora and the creation of new public-use structures, like the Southeast Fountain House. Built at a time of extensive democratic building, the Klepsydra fountain house provided easy access to water for anyone on the main

[130] Andrew Lintott, "Aristotle and Democracy," in *The Classical Quarterly*, vol. 42, no. 1 (UK: Cambridge University Press on behalf of the Classical Association, 1992): 116-117. Aristotle acknowledges this feature of democracy in Book 6 of the *Politics* and argues that the city should make the citizens "good and just" when he dismisses oligarchy in 1280a-25ff. Then, in Book 2 (1261a-b), Aristotle argues against Plato, characterizing the city as diverse and requiring equal participation in government. It is not relevant to the topic of this paper but should be noted that Lintott then explains that Aristotle is still not accepting democracy as the best form of governance, but instead attempts to redefine a militaristic-timocratic system of government which operates with the aforementioned democratic tenets as guiding principles (1992: 118).
[131] Lintott, 1992: 117.

road up the Akropolis or on the hilltop in an inherently democratic location. The role of the Asklepieion on the Akropolis as a public hospital put individual healing worship within the purview of the state-maintained religion. These waterways show a dedicated shift from the private use of water and tyrannical building works to a new conception of a democratic, fully public and communal way of engaging with the city and its resources. That is, a new Athens that was not marked by "private water, gathered from wells, but public water, regulated and maintained by the state."[132] However, this does not mean that the tyrannical works were abandoned: the Peisistratid aqueduct and pipe system remained in use well after the end of the tyrants.

In Athens, during the 5th century BCE, the cleanliness of the street and urban waste was the responsibility of the state, while household water and waste were the private responsibility of homeowners, although this responsibility really just consisted of ensuring they were connected to the Great Drain system and going to collect water from public fountains.[133] The necessary public water systems devised in Athens under the democracy—the shift away from private house wells to more public fountains and especially the building of the Great Drain—show a greater sense of responsibility to an equal citizenry.

In tyrannical *poleis* the tyrant was tasked with providing for the citizens and for the *demos* in particular, since it was often the common people who gave the tyrant the greatest support in ruling the city. Since the tyrant is characterized by his reliance on popularity, tyrannical building projects are often flashy, and exhibit both the wealth of the city and the personal wealth of the tyrant. They are functional, but function and aesthetic are equally as important in their design. This is suggested by black-figure *hydriai* from the archaic period, which seem to have gained

[132] Paga, 2015: 385.
[133] Yannopoulos et al, 2017: 169. Wycherley, 1962: 200.

prominence throughout the latter half of the 6th century in Athens as Peisistratos and his sons erected more and more building projects, particularly fountains.[134] These *hydriai* often depict women filling up their own *hydriai* in fountain houses [fig. 4]. The painters may have been referring to specific fountains or may have simply tried to capture the grandeur of similar fountains in the ancient world. The attention paid to the design of the fountainheads on the *hydria* suggests the importance of fountains in antiquity, as well as the prominence of fountain design. That women are depicted most often on these *hydriai* illustrates how public these fountains were: they were not only open to citizen men, but to women, slaves, *metics*, and foreigners. The *kolymbethra* in Akragas is a good example of water management under a tyrant, and the purported Enneakrounos is a nice example in Athens.

This social contract for public space can be seen under all forms of government in the ancient world, but the strongest compacts between the citizens and the state are necessarily between those governing and those benefitting in a democracy, since they are one and the same. This compact applies only to the citizens who have the ability to govern, but it is in their best interest to improve all public facilities, from which women, *metics*, and other outsiders and non-citizens also benefitted. Under an oligarchy or a monarchy, where those in power are not so beholden to the people of the city, the threat of *stasis* might be considered reason enough to maintain public services, however, there are not the same stakes as under a democracy or tyranny. In the former, the people who use public services are the people who are commissioning them, and in the latter, the tyrant has been bolstered into power by popular support. Provisions for water management in the *polis* are thus a compact between the state and its citizens.[135]

[134] Camp, 2004: 37. On the *hydria* in figure 4, the fountain is ornate and draws as much focus as the female figures depicted.
[135] Lintott,1992: 117, fn.5. Drawing on Aristot.*Pol.*128b10ff.

The prevalence of Athens in scholarship and the relative lack of ancient sources on the theories and methods of urban planning during the colonization of southern Italy does not mean that the settlers of Akragas and Metaponto were unaware of common ideas of siting and building a city. In Akragas and Metaponto, however, the ideological divide is less prevalent and less studied since the democratic periods seem to have been fairly brief and after the cities began to decline in prominence.[136] It is evident though that in these two *poleis*, water management was considered and deliberately built into the city plan of these colonies very early in their history. Both cities make use of the hydrogeological features of the land of their sites and show evidence of careful planning.

Akragas had elevated temples on the ridges of the city's natural fortifications, so that the sacred was always above the *polis* and its people; extensive aqueduct and water systems culminating in a public pond for the citizens' use, likely very close to the agora; and private homes laid out on a grid with orderly streets. This all fits neatly with Hippodamos' supposed theory of total city planning and land-allotment for the sacred, the public, and the private. Akragas had a brief democratic period but most of the water projects are easily attributed to the tyrant Theron, and the mysterious Phaiax. The *kolymbethra* can and should be considered an example of a tyrannical building project; a means for a tyrant to impress, reward, and distract the people of his city. Tyrants were often demagogues and had a vested interest in maintaining a good relationship with the *demos*, which they did through grand building projects and lavish feast days. Since the *kolymbethra* was meant for public use (swimming, fishing, leisure activities), it is very likely that it was constructed as a gesture of goodwill by a benevolent tyrant.

[136] The changes in building programs in these periods deserve a more in-depth study, but because of the relative dearth of information on the democratic periods in Akragas and Metaponto, they are outside the scope of this current investigation.

However, due to the nature of the hydrologic landscape of Akragas—which has several runoff channels, underground karst channels, and aqueducts pulled by gravity to accumulate in the southwest corner of the Akragas basin [fig. 17b]—the choice presented to the Akragantines was to either divert the natural course of the water or make use of it through a water feature in that area. A leisure pool was certainly the simpler option.

Another of Theron's tyrannical building projects was the Temple of Olympian Zeus at Akragas. It was the largest Doric temple ever constructed, situated far above the urban centre of Akragas, on the southern ridge of the Ridge of Temples, a significant religious site.[137] Polybius writes that "The city is adorned on a grand scale by temples and colonnades, especially the temple of Olympian Zeus, which, although never completely finished, in design and size is not surpassed by any temple throughout Greece."[138] Diodorus Siculus tells us that it was built by Carthaginian slaves, prisoners of war taken at the Battle of Himera, prisoners who he also credits with building the *kolymbethra* and underground water channels. The gargantuan scale of the temple, as well as its position above the *asty* and the use of foreign slaves to build it, made it an impressive monument to the power of Akragas and to Theron more specifically.

As difficult as it is at Athens to attribute buildings to tyrants or the democracy, the historical record is even more opaque in Metaponto. In the archaic period, there was a period of tyranny, possibly followed by oligarchy in the late 6th and early 5th century BCE. There is an intriguing period of diplomatic contact with Athens in 413 BCE, which could imply democracy at Metaponto at this time.[139] However, the substantive usage of the canals and water systems at

[137] Burns, 1974: 397-398, drawing from Polybius.
[138] Polyb.9.27: κεκόσμηται δὲ καὶ τἆλλα μεγαλοπρεπῶς ἡ πόλις ναοῖς καὶ στοαῖς. καὶ μὴν ὁ τοῦ Διὸς τοῦ Ὀλυμπίου νεὼς παντέλειαν μὲν οὐκ εἴληφε, κατὰ δὲ τὴν ἐπιβολὴν καὶ τὸ μέγεθος οὐδ᾽ ὁποίου τῶν κατὰ τὴν Ἑλλάδα δοκεῖ λείπεσθαι. Burns, 1974: 397-398.
[139] Krasilnikoff, 2010: 114.

Metaponto did not change. The Bradano-Basento division lines and canals line up with the street grid of the *asty*, and the canals themselves follow the natural waterways in the karst almost exactly, suggesting that Metaponto was intentionally designed with an eye to the use of the whole area and the advantages of its geography. Again, this is something very similar to the total urban planning of Aristotle's Hippodamos. Further, the public and religious part of the city (the agora and temples) is divided from the residential by *Plateia* A,[140] while the Metaponto *chora* has several extra-urban temples and *necropoleis*. Hippodamos' tripartite division of the *polis* seems to be reflected in the design of the colony. The multiple building stages (the two watersheds between the Bradano and Cavone rivers) in the *chora* suggest a more needs-based strategy of urban planning rather than theoretical. Despite this practical approach, it appears that there was some consideration of theory when Metaponto was laid out, since the ideas that Aristotle would later attribute to Hippodamos match the actual urban plan quite well.

Although Metaponto was ruled by tyrants for most of its history, there is a mid 6th century structure in the agora which points to community-minded organization not long after the city's foundation: the '*ekklesiasterion*' [fig. 24a] The Metaponto *ekklesiasterion* is the largest and oldest such structure in antiquity, even compared to Athens. This *ekklesiasterion* suggests that the tyrant or *demos* of Metaponto were thinking of ways to gather in a community. There is evidence of small, wooden bleachers, *íkria*, in the same area in the 7th century, probably for a similar purpose to the later monumental structure [fig. 24b].[141] Despite its name, archaeologists are uncertain of the building's use and many Metaponto scholars now doubt that it was a specifically political assembly point.[142] Even though the *ekklesiasterion* may not have been an

[140] Dinu Adamesteanu, "Enciclopedia Italiana: Metaponto" (accessed: 2022): https://www.treccani.it/enciclopedia/metaponto_%28Enciclopedia-Italiana%29/.
[141] Carter, 2006: 204.
[142] Carter, 2006: 204.

assembly space for deciding public policy that does not mean it was an apolitical space. In the broadest sense, any space designed for a community to gather in that allows for conversation and community planning is an inherently political space, since "man is by nature a political animal."[143]

Though Hippokrates' treatise was written approximately a century (ca. 400 BCE) after the initial development period of the Athenian classical agora, over two centuries after the founding of Akragas, and nearly three centuries after the establishment of Metaponto, the ideas in it can easily be applied to the water systems in these cities because of their prevalence in Greek society. Many of the springs and fountain houses and even waste systems follow the orthogonal lines of the city streets and the suggested sources and 'healthy water' concerns that Hippokrates, Vitruvius, Aristotle, and others prescribe. These ideas can be found in natural science texts, political texts, medical and engineering texts, and as far back as Homer. Considerations of water and the environment in combination with urban design did not begin with Hippokrates or Plato.

However, Akragas and Metaponto, Athens, Rhodes, Korinth, and most *poleis* in the Mediterranean all show a preference or, more accurately, a need for an abundant water supply, drowning out the theorists' condemnations of marshland. Even in Rome, the *Cloaca Maxima* was built in the early years of the Republic or perhaps during the reign of kings, in order to drain the swamp land of Rome. The abundance of rock-source springs throughout Ancient Greece and Rome contradicts Hippokrates' disdain for mineral-heavy water. These ideas do seem to have influenced some of the water systems in antiquity, but, when necessary, settlers and citizens showed some flexibility and ignored these theorists, working with the practical hydrogeological reality.

[143] Aristot.*Pol*.1.1253a: ὁ ἄνθρωπος φύσει πολιτικὸν ζῷον. Sourced from Perseus Tufts.

The Metaponto division lines and water management system may be attributed to some unknown tyrant or perhaps an oligarchy of early settlers, but they continued to be used and maintained into the 3rd century BCE; even during a period of democracy, the canals continued to function. This evidently happened at Akragas and in Athens as well. In Athens, the democratic government did not discontinue the use of tyrannical waterworks—on the contrary, Peisistratos' aqueducts and pipe system continued to be used after the tyrannicide and was actually expanded in the 5th century. There does seem to have been a desire to distance the democracy from the rule of the tyrants, with a new agora and the Pnyx, but despite closing the archaic wells around the *polis,* efforts in water management seem to have focused on expanding and improving existing structures, rather than replacing them. Because they were colonies, founded by well-established *poleis*, Akragas and Metaponto had sophisticated water management systems already built into their city plans from their founding. They are *designed* cities, as opposed to Athens, which grew more organically.

Water is an essential resource for any settlement to survive, let alone thrive. Despite tyrannical building programs, it is clear that water was a provision of the community in these *poleis*. The *demos* maintained and used fountain houses and other water systems as a community, rather than solely relying on the tyrant's 'top-down' management. This is made evident by the continuous use and expansion of water systems throughout changing regimes. Although they were authored by tyrants, these waterways were part of general civic services. They were not alone in the Mediterranean, many other cities—including Athens—treated their water infrastructure as a resource that should be available to all, a provision for the community by the community. Water management and infrastructure became the concern of the *demos*. This way of considering water as a civic service increasingly became the norm for the Greek *poleis*, and by

the Roman period, it was a perceived benefit of Empire for many ancient cities. As the water systems at Akragas and Metaponto illustrate, though their inception may have come from tyrannical ambition, ultimately, they thrived through citizen operation. As cities developed and governments changed, water management shifted from an extravagant display of a tyrant's goodwill and power to an expression of what the community could be expected to provide.

Images

Aerial Plan of the Agora

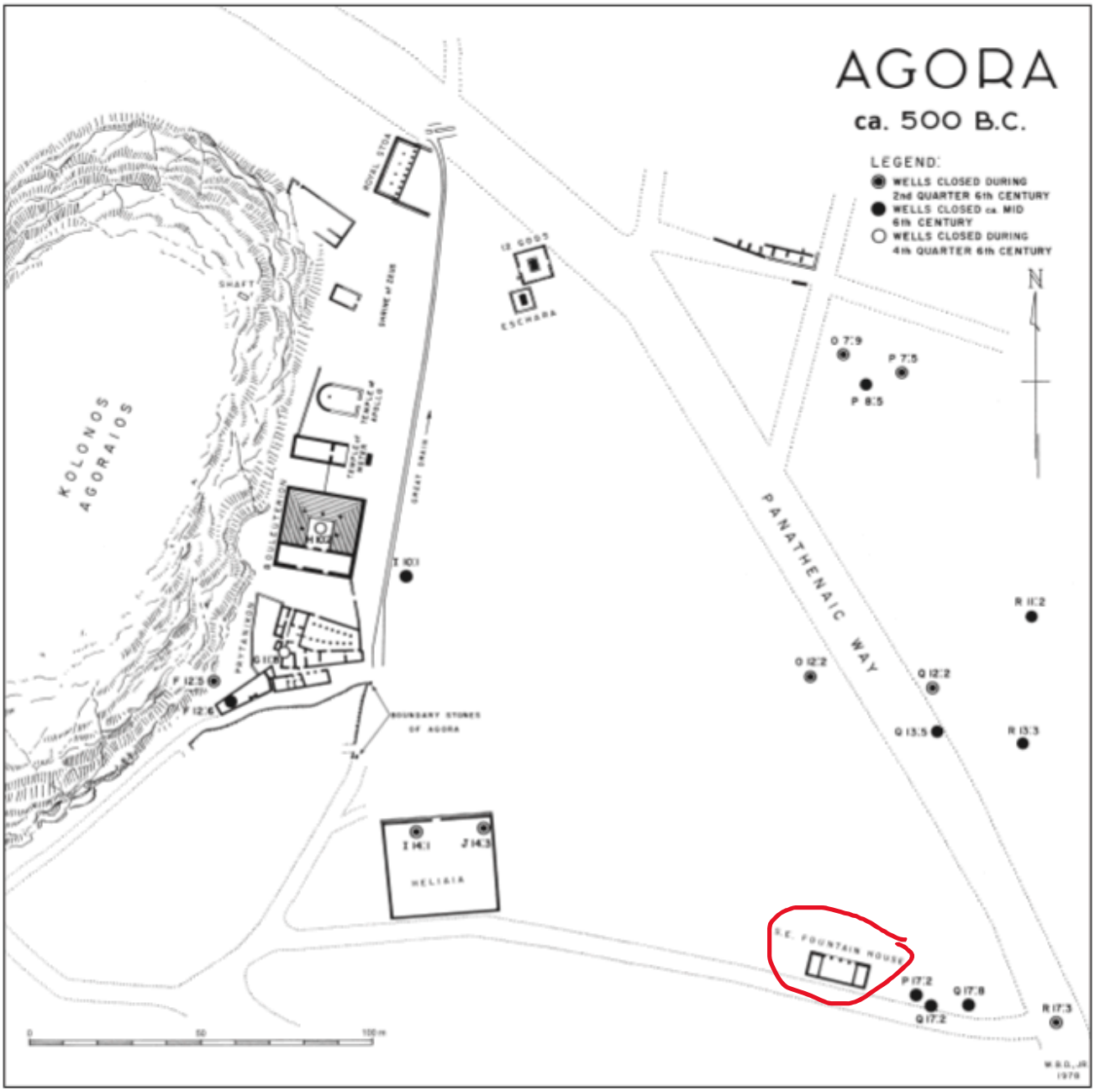
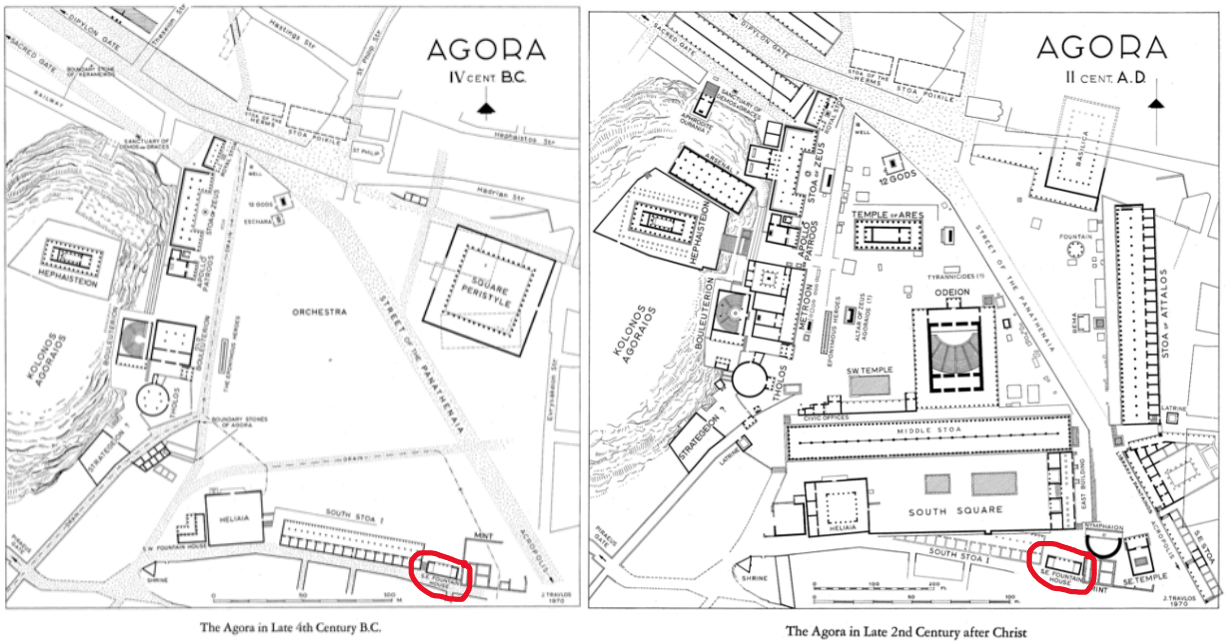


Figure 1. Shows the layout of the agora sub-basin ca. 500 BCE. Sourced from Paga, 2015: 380, with the location of the Southeast Fountain House marked out by my addition of a red circle.



The Agora in Late 4th Century B.C. The Agora in Late 2nd Century after Christ

Figure 2a (left). Aerial plan of the classical agora in the 4thC BCE, as Thucydides likely would have known it. Figure 2b (right). Aerial plan of the agora Pausanias would have known. Both sourced from Wycherley, 1957: 261, 263, with the location of the Southeast Fountain House marked out by my addition of a red circle.

Figure 3. Drawing of the classical agora showing Pausanias' path. Sourced from Dickenson, 2015: 731.

Black-Figure *Hydria*

Figure 4. Black-figure *hydria* showing women collecting water at an impressive fountain. "ca. 520-500 BC, attributed to the AD Painter, London, British Museum 1843-1103.49." Sourced from Paga, 2015: 383.

Southeast Fountain House

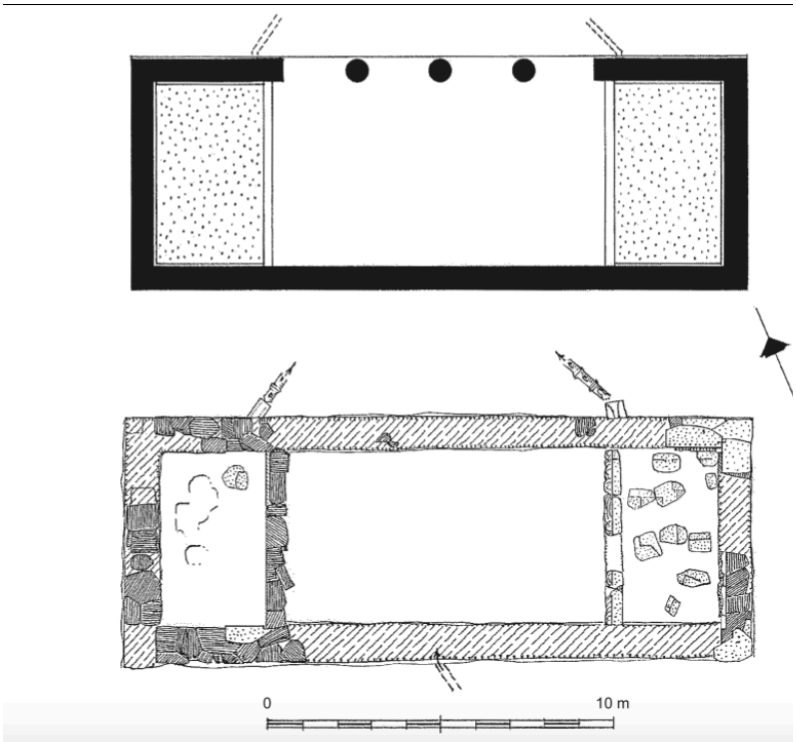


Figure 5a. Aerial plan of the Southeast Fountain House, restored at top and current ruin at bottom. Sourced from Paga, 2015: 358.

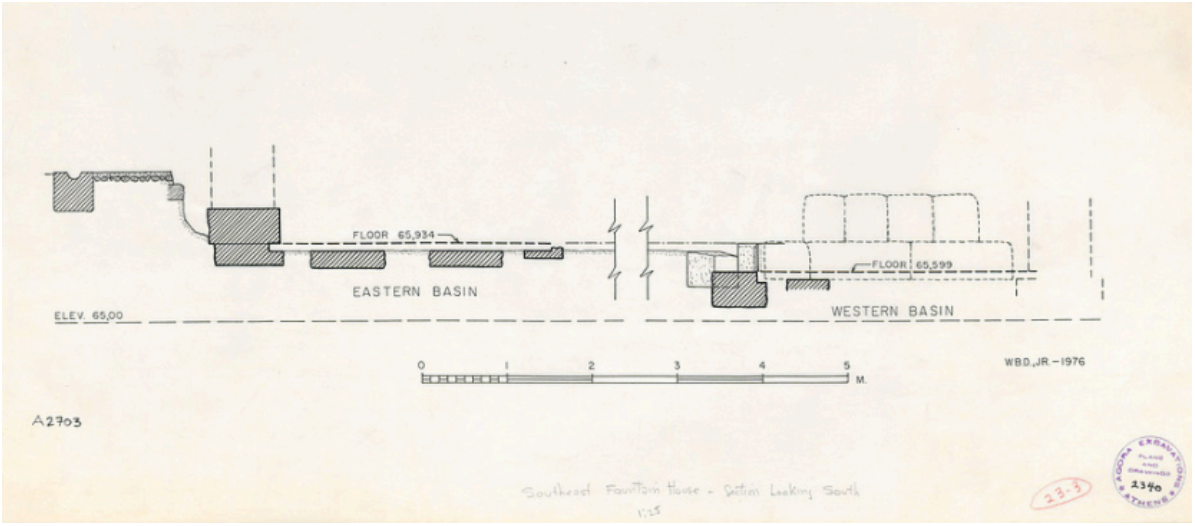


Figure 5b. Architectural cross-section of the base of the Southeast Fountain House. Sourced from ASCSA.net Agora Drawing: PD 2340 (DA 2703).

Figure 6a. Northeast corner of the Southeast Fountain House with claw-tooth chisel marks visible. Sourced from Paga, 2015: 365.

Figure 6b. Northeast corner of the Southeast Fountain House with Z-clamp cutting visible. Sourced from Paga, 2015: 359.

Great Drain

Figure 7a (left). Aerial view of the main channel of the Great Drain next to the base of the Eponymous Heroes monument. Sourced from ASCSA.net Agora Image: 2000.03.0008.
Figure 7b (right). A view of the Great Drain with 4thC branches visible. Sourced from ASCSA.net Agora Image: 1997.04.0273 (4-285).

Figure 8a (left) A view inside the Great Drain. Sourced from ASCSA.net Agora Image: 1997.04.0289 (85-342).
Figure 8b (right). Side view of the interior wall of the Great Drain. Note the visible polygonal masonry. Source form ASCSA.net Agora Image: 1997.04.0260 (2-209).

Figure 8c and 8d. Photos by the author of a Great Drain channel showing the interior and roof slabs.

Klepsydra Fountain

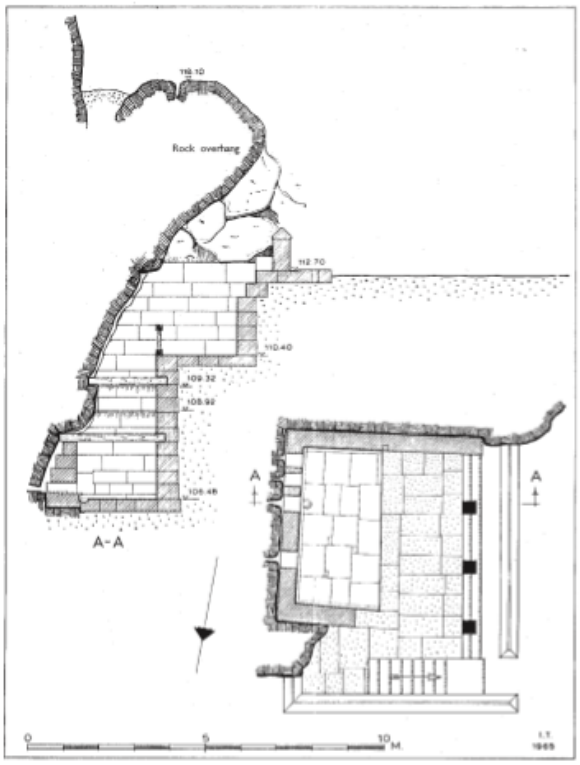


Figure 9a (left). Photo by the author showing the rock-face of the Klepsydra Fountain with sacred caves above.
Figure 9b (right). Architectural cross-section of Klepsydra Fountain with the plan of the nearby limestone court. Sourced from Camp, 2004: 71.

Figure 9c (left). Photo by the author showing the limestone court of the Klepsydra Fountain.
Figure 9d (right). Photo by the author showing the rock-face of the Klepsydra Fountain with a corner of the drawing-well visible at the bottom middle and part of the limestone court visible.

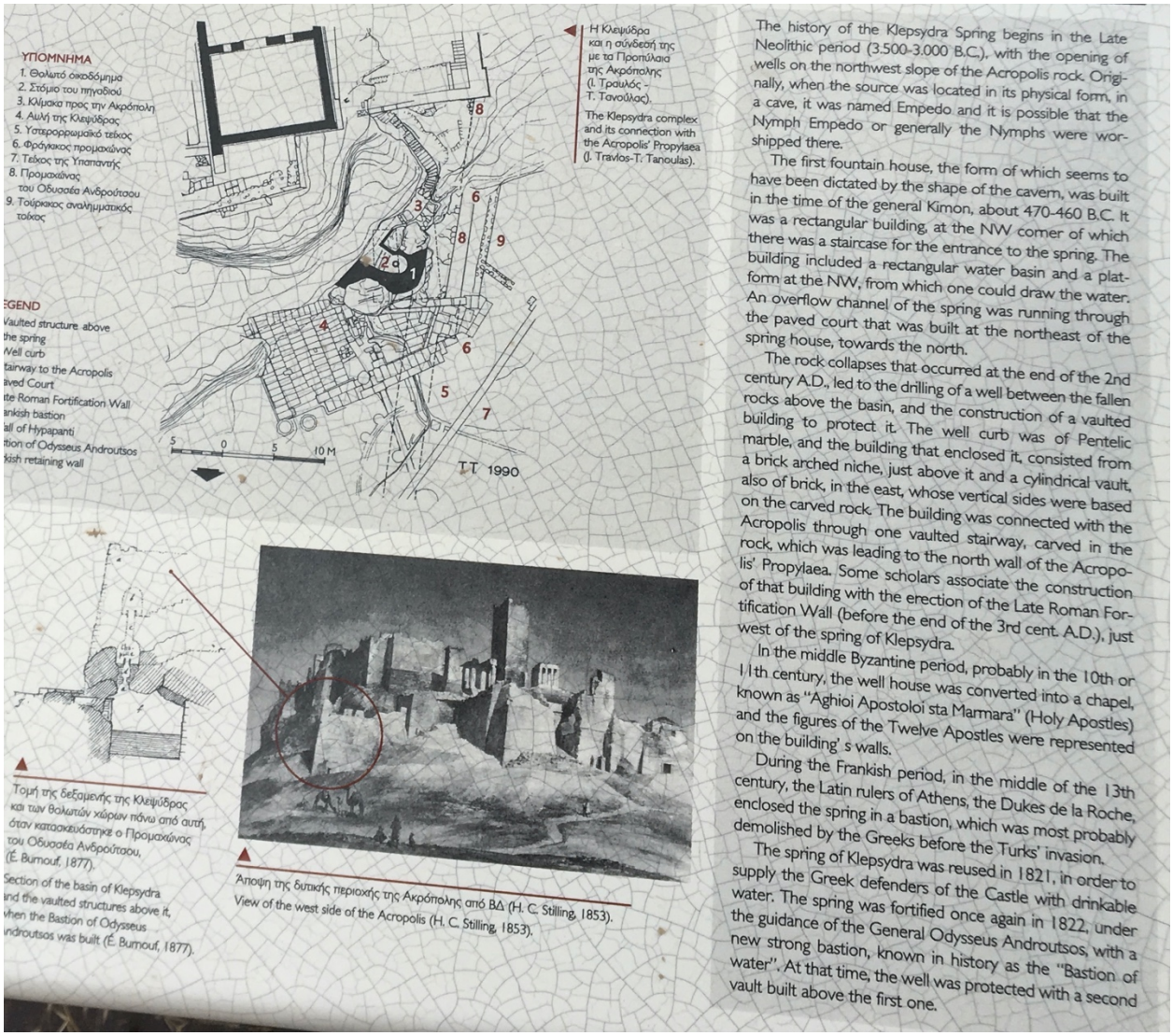


Figure 9e. Photo by the author of the Klepsydra placard on the Akropolis.

Asklepieion

Figure 10. Photo by the author of the ruins and reconstruction of the Doric stoa of the Akropolis Asklepieion.

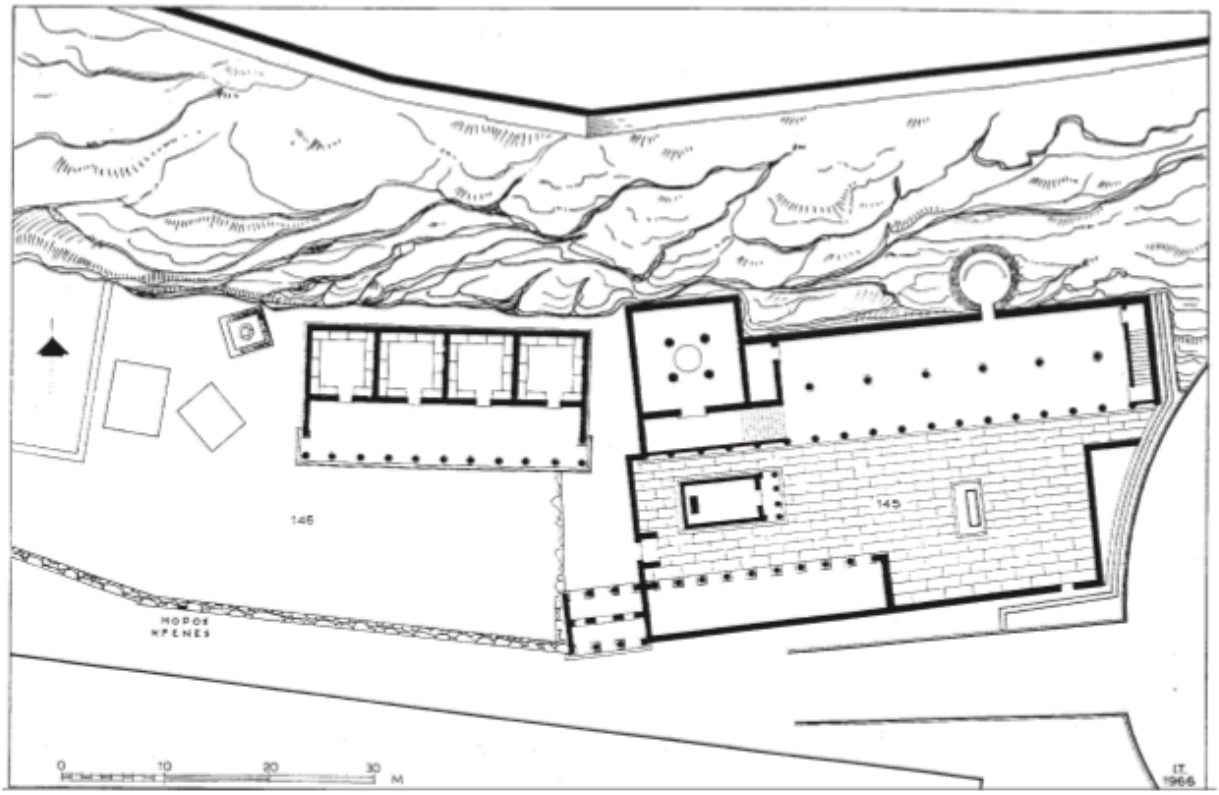


Figure 11. Aerial plan showing the Akropolis Asklepieion ca. 4thC BCE with Roman expansions. Sourced from Camp 2004: 154.

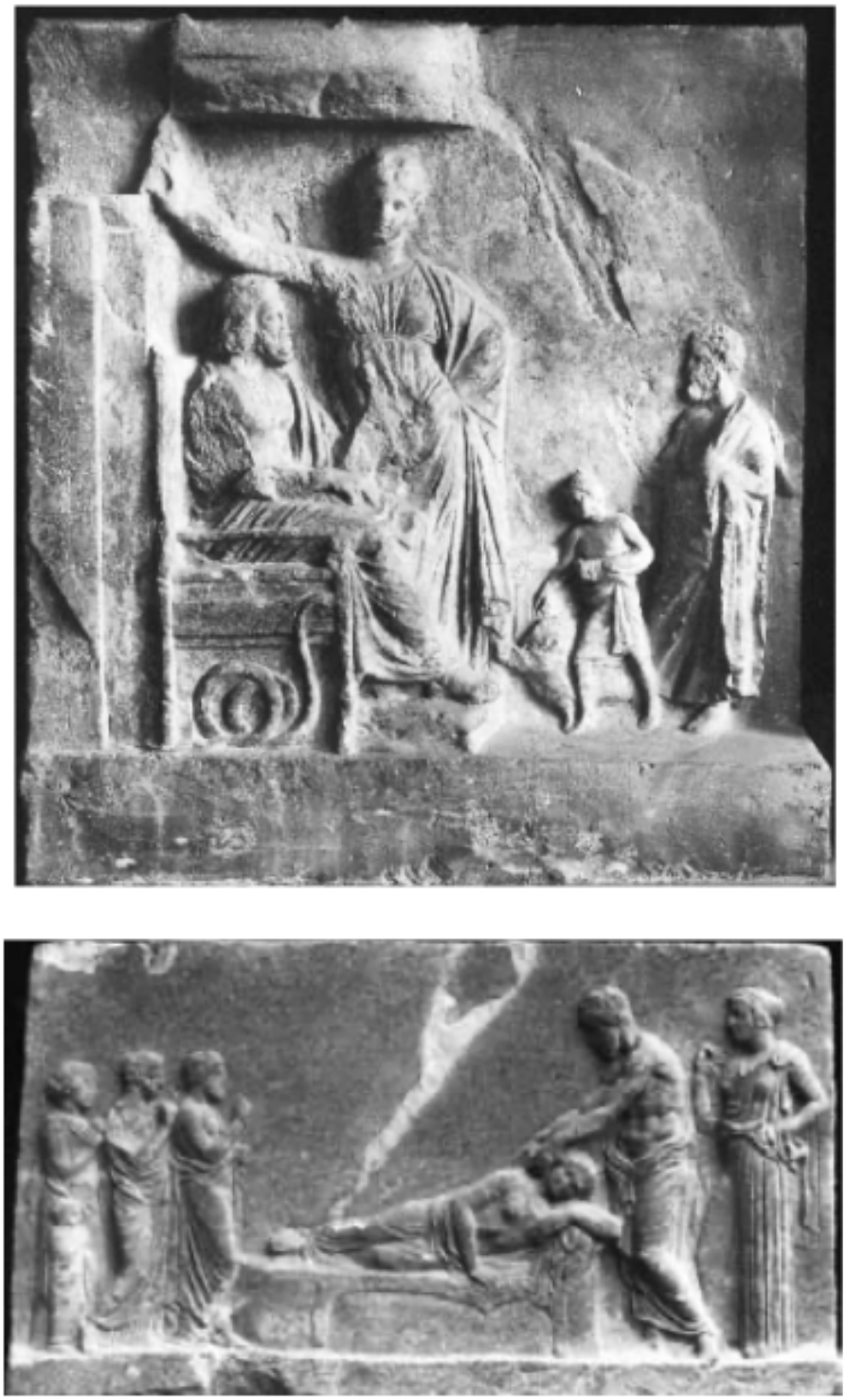


Figure 12a (top). A votive relief depicting Asklepios and Hygieia with worshippers from the Akropolis Asklepieion. Figure 12b (bottom). A votive relief depicting Asklepios communing with a sleeping patient from the Asklepieion at Peiraeus. Sourced from Camp, 2004: 122-123.

Magna Graecia

Figure 13. A map of southern Italy, the site of Magna Graecia, with Metaponto near Lucania and Akragas in Sicily. (https://www.money.org/collector/aidan/blog/sybaris-an-incuse-design)

Akragas

Figure 14a (right). Looking up at a natural ridge outside Akragas (https://lifeinitaly.com/agrigento-area/).
Figure 14b (left). A view along the top of the Ridge of Temples (https://www.contexttravel.com/blog/articles/valley-of-the-temples-sicily).

Figure 15. A view from the garden in the Valle dei Templi, the site of the *kolymbethra* in antiquity (https://www.parcovalledeitempli.it/en/paesaggio/il-giardino-della-kolymbethra/).

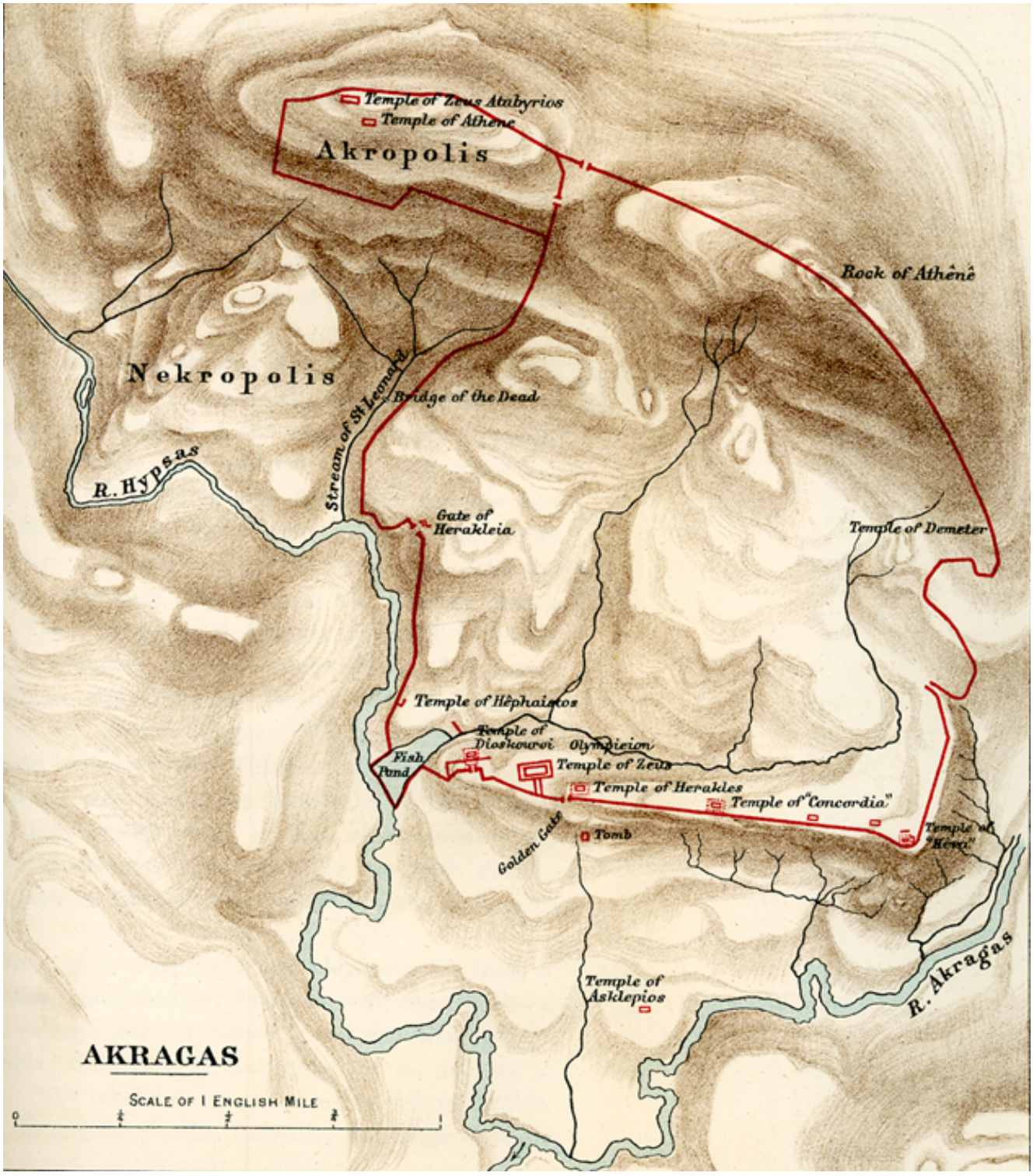


Figure 16. A simple representation of the site of Akragas, including the *kolymbethra* (here marked "Fish Pond") and various important sites and temples along the ridges surrounding the site. (https://www.ajaonline.org/imagegallery/1154#1).

Figure 17a. Akragas urban centre with its orthogonal plan depicted (https://www.ajaonline.org/imagegallery/1154#6).

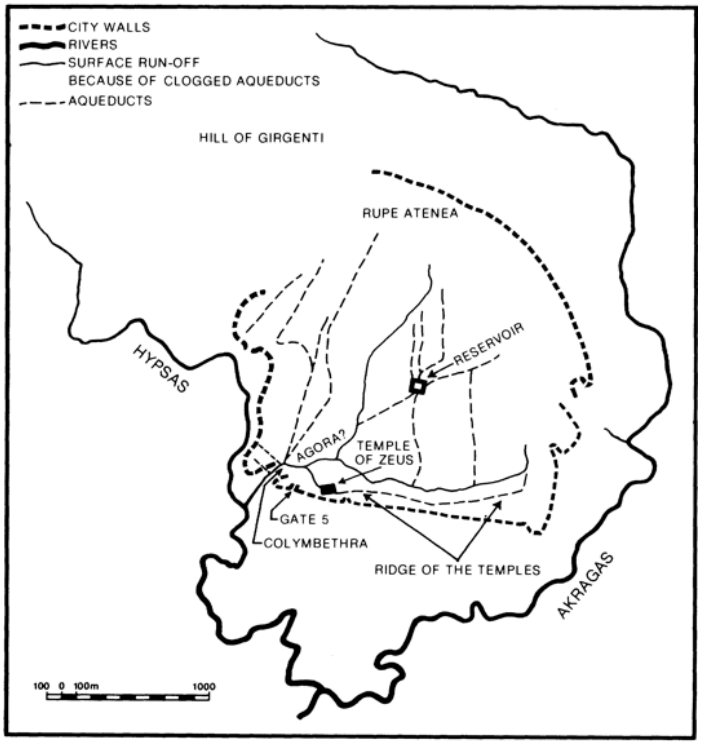


FIG. 2.—Ancient Acragas (modern Agrigento)

Figure 17b. Akragas *asty* with the *kolymbethra* and the reservoir and other water systems marked out (Burns, 1974: 398).

Metaponto

Figure 18a. The *chora* of Metaponto showing the division lines in the Bradano-Basento watershed (right) and Basento-Cavone watershed (left) (Carter, 2009: 96).

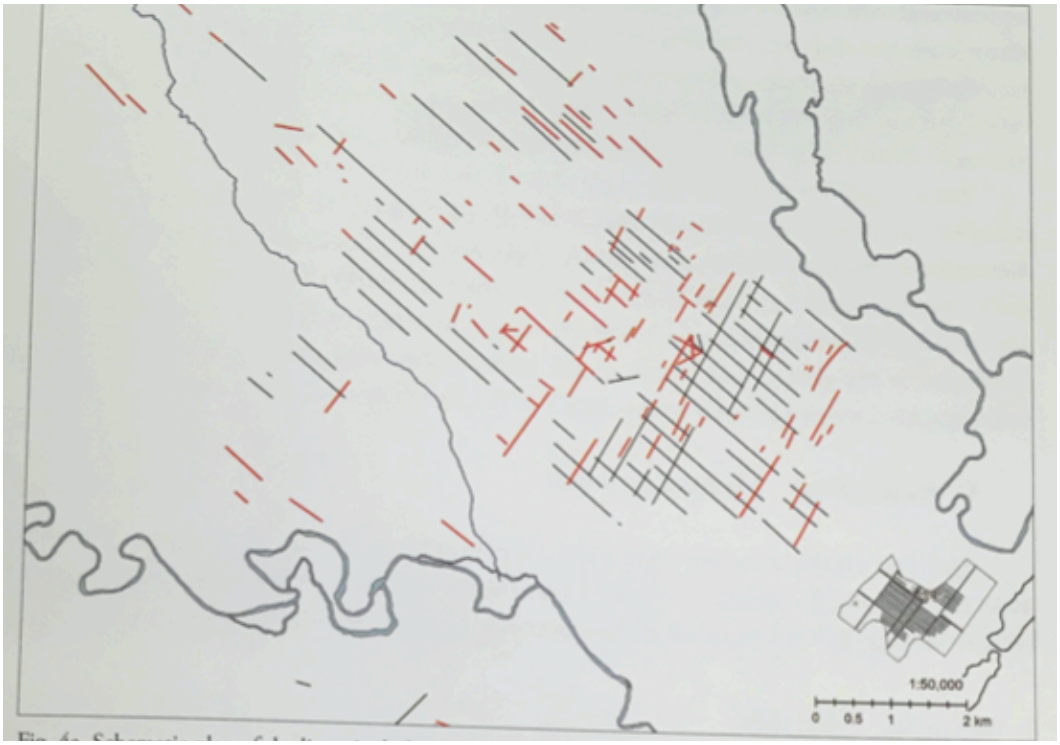


Figure 18b. Division lines in the Bradano-Basento watershed in the *chora* at Metaponto (Carter, 2020: 211).

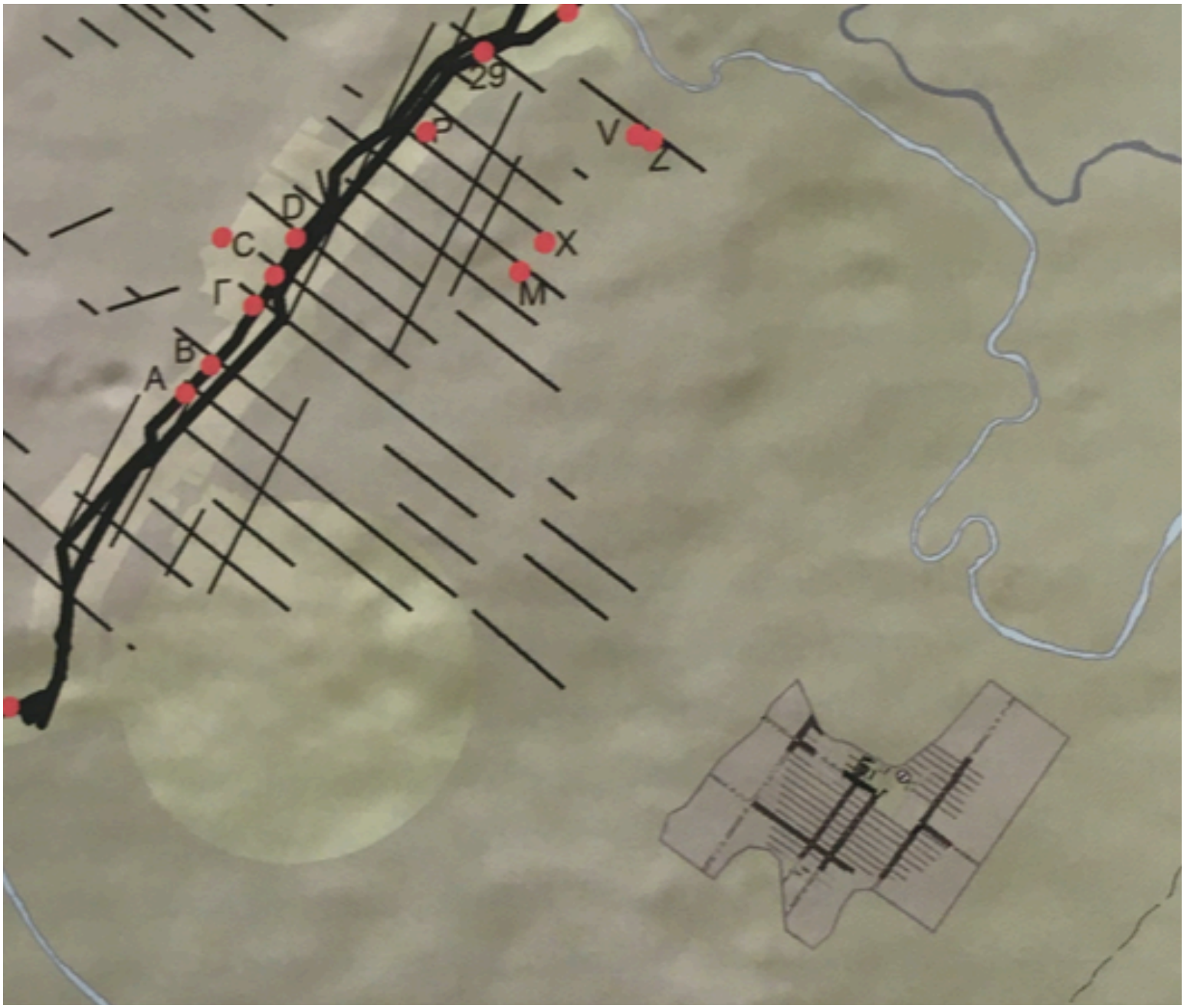


Figure 19a. Detail of a schematic plan of the division and canal lines of the *chora* and the urban centre for comparison of their corresponding grids (Carter, 2020: 218).

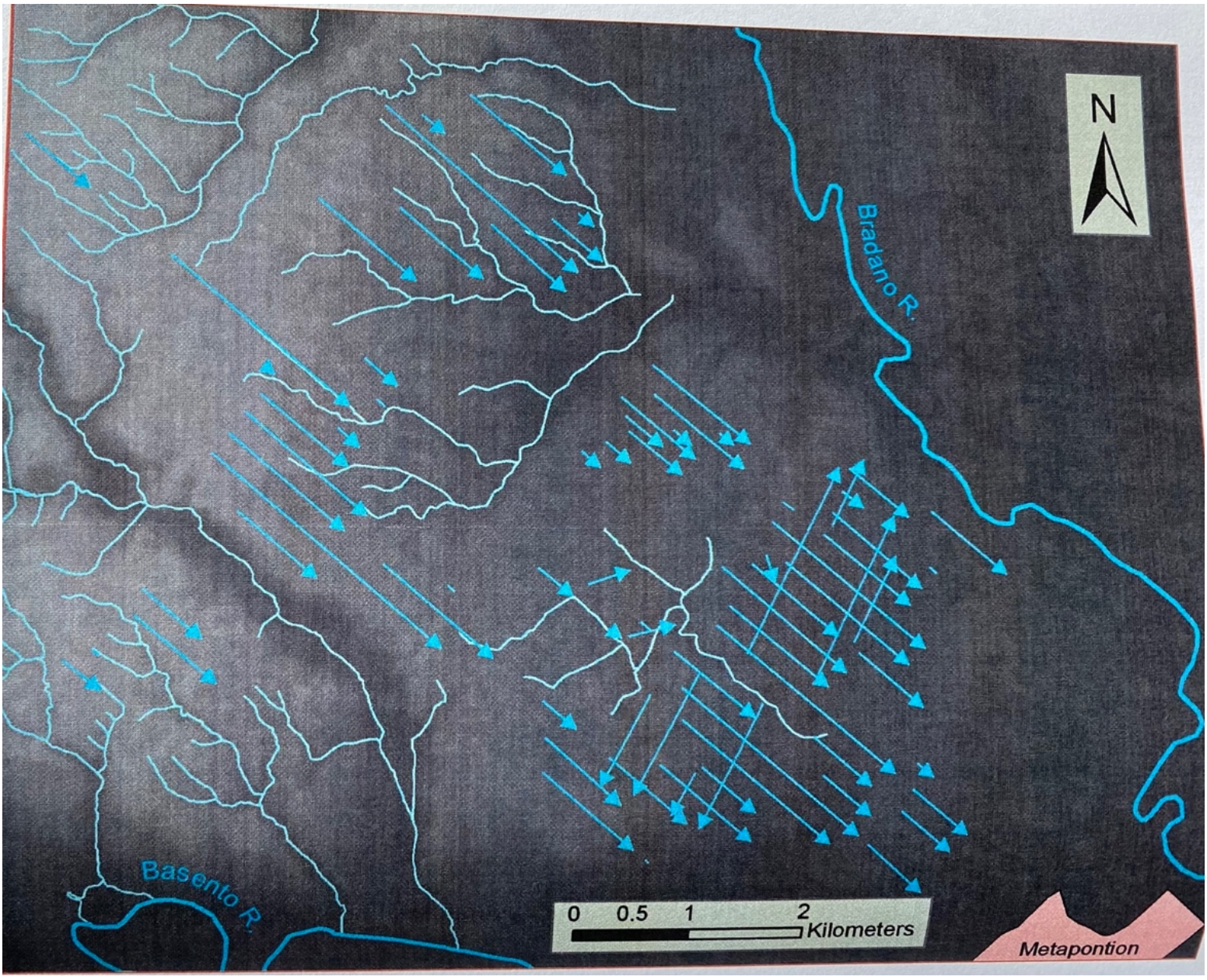


Figure 19b. Representation of the expected waterflow in the division lines of the *chora* based on the hydrology of the plain, with the *asty* of Metaponto in the bottom right (Prieto, 2005: 235).

Figure 20a. “Pantanello necropolis, view along division line L21a and canal feature… Institute of Classical Archaeology)” (Carter, 2020: 213).

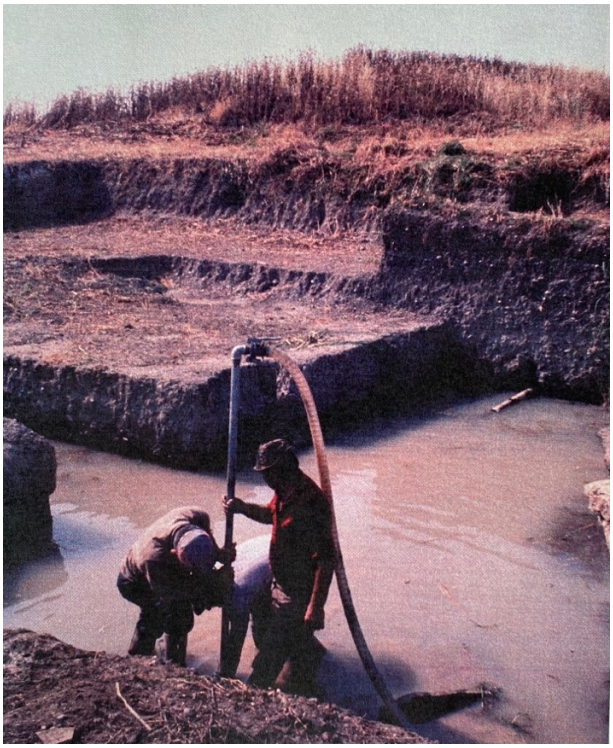


Figure 20b. Flooding in an excavated trench at the Pantanello Sanctuary in the Metaponto *chora* (Prieto, 2005: 234).

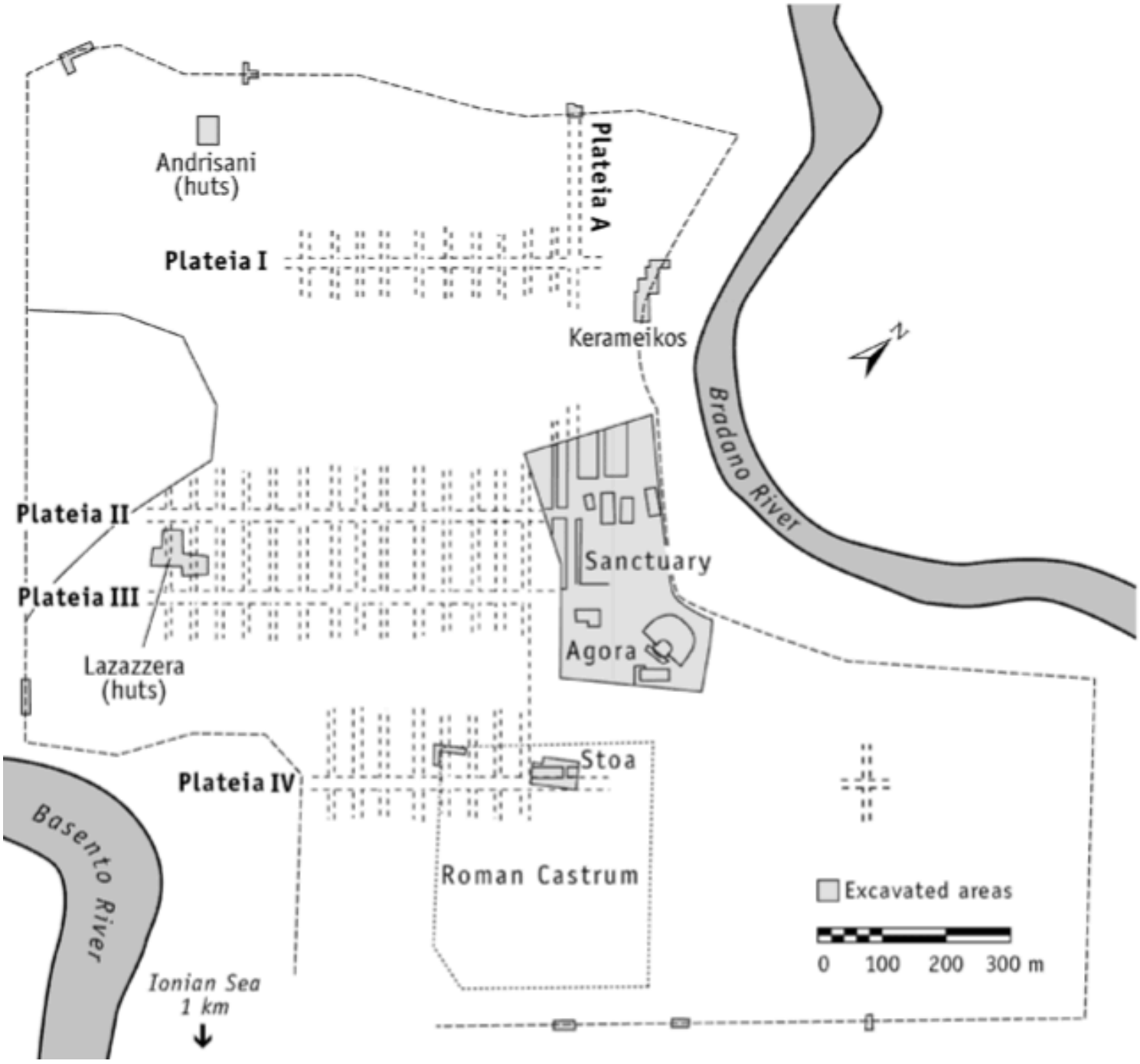


Figure 21. City plan of Metaponto showing the regular grid plan and the separation of residential from sacred (Carter, 2006: 198).

Figure 22. Photo by the author of a reinforced canal in the *asty* of Metaponto, perpendicular to *Plateia* A.

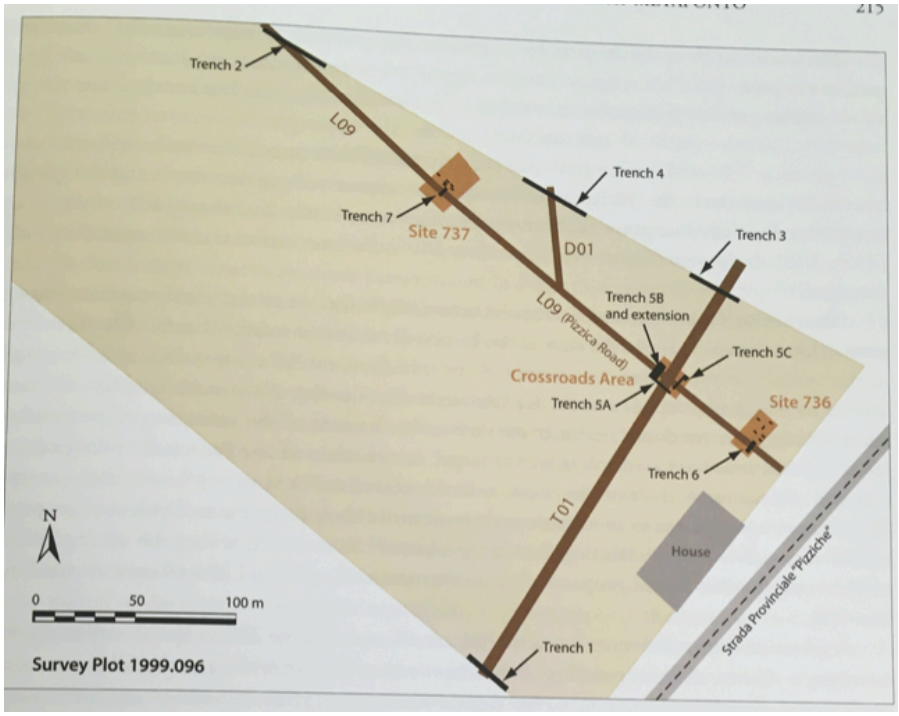


Figure 23. "Plan of the excavations across and along lines, including two necropoleis (sites 736 and 737)… University of Texas Press 2011)" (Carter, 2020: 215-6). T01 is a perpendicular canal channel, while D01 appears to be something of a feeder channel intended to aid in the drainage of the *chora*. It seems at least part of T01 had a similar function as well.

Figure 24a (left). Photo by the author of a small canal in the *asty* with the exterior of the *ekklesiasterion* visible in the top right corner.
Figure 24b (right). Photo by the author of the interior of the *ekklesiasterion*.

Bibliography

Abrahams, Harold. "The Water Supply of Rome." In *Journal (American Water Works Association)*, vol. 67, no. 12. US: Wiley, 1975. 663-668.

Adamesteanu, Dinu. "Enciclopedia Italiana: Metaponto." Accessed: August 18, 2022. https://www.treccani.it/enciclopedia/metaponto_%28Enciclopedia-Italiana%29/.

Anderson, Greg. "Before *Turannoi* were Tyrants: Rethinking a Chapter of Early Greek History." *Classical Antiquity*, vol. 24, no. 2, 2005: 173-222.

Aristotle. *Politics*. Translated by T.A. Sinclair; revised by Trevor Saunders. England: Penguin Books Ltd., 1957.

ARUP (2022). Accessed: August 20, 2022. https://www.arup.com/expertise/services/planning/masterplanning.

ASCSA (American School of Classical Studies at Athens). *ASCA.net: Excavations in the Athenian Agora*. http://www.agathe.gr/. Source of images of the Great Drain.

Berking, Jonas, Brian Beckers, Daniel Knitter, Brigitta Schütt. "Problems Concerning Ancient Water Management in the Mediterranean." In *Topoi: Journal for Ancient Studies*, vol. 6, 2016: 74-101.

Brennan, Maura. "A Comparative Analysis of Five Greek Fountain Houses." Virginia: Unpublished dissertation at the College of William and Mary, 2015.

Broneer, Oscar. "A Mycenaean Fountain on the Athenian Acropolis." *Hesperia*, vol. 8, no. 4, 1939: 317-433.

Burns, Alfred. "Ancient Greek Water Supply and City Planning: A Study of Syracuse and Acragas." In *Technology and Culture*, vol. 15, no. 3, 1974. 389-412.

Burns, Alfred. "Hippodamus and the Planned City." In *Historia: Zeitschrift für Alte Geschichte*, 4th quarter, 1976. 414-428.

Camp, John McKesson II. *The Archaeology of Athens*. New Haven: Yale University Press, 2004.

Carter, Joseph Coleman. *Discovering the Greek Countryside at Metaponto*. Thomas Spencer Jerome Lectures. USA: University of Michigan Press, 2006.

Carter, Joseph Coleman. "Controlling Water, Dividing Land: Ancient Bonifica at Metaponto." In *Opere di Regimentazione delle Acque in Etá Arcaica: Roma, Grecia e Magna Grecia, Etruria e Mondo Italico*. Edited by Elisabetta Bianchi and Matteo D'Acunto. Rome: Edizioni Quasar di Severino Tognon, 2020.

Carter, Joseph Coleman and Alberto Prieto (eds.). *The* Chora *of Metaponto 3: Archaeological Field Survey Bradano to Basento.* Austin: University of Texas Press, 2011.
-- Folk, Robert. "Geologic Background of the Metapontino." 3-30.
-- Abbott, James. "Geomorphology and Geoarchaeology of the Metapontino." 31-68.

Castagnoli, Ferdinando. *Orthogonal Town Planning in Antiquity*. USA: Cambridge University Press: 1971.

Castagnoli, Ferdinando. "Appendix (1970)." In *MIT Press Open Architecture and Urban Studies: Orthogonal Planning in Antiquity*. Mass.: MIT Press, 2021.

Chiotis, E.D. and L.E. Chioti. "Water Supply of Athens in the Antiquity." *Evolution of Water Supply Through the Millenia*. Edited by Andreas Angelakis, Larry Mays, Demetris Koutsoyiannis, and Nikos Mamassis. London: IWA Publishing, 2012.

Chiotis, E.D. and L.E. Chioti. "Drainage and Sewerage Systems at Ancient Athens, Greece." *Evolution of Sanitation and Wastewater Technologies through the Centuries*. Edited by A.N. Angelakis and J.B. Rose. London: IWA Publishing, 2014.

ClearPoint Strategy. USA: Ascendant Strategy Management Group, 2022. Accessed: August 20, 2022. https://www.clearpointstrategy.com/types-of-urban-planning/.

Crouch, Dora. *Water Management in Ancient Greek Cities*. USA: Oxford University Press, 1993.

Crouch, Dora. *Geology and Settlement: Greco-Roman Patterns*. USA: Oxford University Press, 2003.

Davidson, C. "Connectivity and Land Division in the *Chora* of Ancient Metaponto: an investigation using Geographic Information Systems." Canada: Unpublished dissertation at McMaster University, 2022.

Dickenson, Christopher. "Pausanias and the 'Archaic Agora' at Athens." *Hesperia*, vol. 84, no. 4, 2015: 723-770.

Diodorus Siculus. *Historical Library.* Translated by C. H. Oldfather. Vol. 4-8. USA: Harvard University Press; London: William Heinemann, Ltd., 1989. From the Perseus Digital Library. Editor Gregory Crane. Online: Tufts University, updated 2019.

Diogenes Laertius. *Lives and Opinions of Eminent Philosophers*. Translated by R.D. Hicks. Cambridge: Harvard University Press, 1972. Online: Tufts University, updated 2019.

Greco, Emanuele. "Sanctuaries of Magna Graecia and Sicily." In *Magna Graecia: Greek Art from South Italy and Sicily*. Edited by Michael Bennett, Aaron Paul, and Mario Iozzo. New York: Hudson Hills Press, 2002. 98-119.

Gorman, Vanessa. "Aristotle's Hippodamos ('Politics' 2.1267b22-30)." In *Historia: Zeitschrift für Alte Geschichte*, 4th qtr. Germany: Franz Steiner Verlag, 1995. 385-395.

Gottesman, A. *Politics and the Street in Democratic Athens*. Cambridge: Cambridge University Press, 2014.

Frantzeskakis, Ion. "By the Banks of the River Ilissos." *Athens Key*. Online, 2020. https://www.athenskey.com/ilissos.html

Herodotus. *The Histories*. Translated by Aubrey de Sélincourt, revised, with introduction and notes by A.R. Burn. England: Penguin Books Ltd., 1972.

Hippokrates. *On Airs, Waters, Places*. Translated by Francis Adams. From *the Internet Classics Archive,* compiled by Daniel Stevenson. Online: Web Atomics, 1994-2009. http://classics.mit.edu/Hippocrates/airwatpl.mb.txt

Hippokrates. *De Aere Aquis et Locis*. Edited by W.H.S. Jones. Cambridge: Harvard University Press, 1868. From the Perseus Digital Library. Editor Gregory Crane. Online: Tufts University, updated 2019.

Hydria Project. "The springs and fountains of the Acropolis hill." *Hydria Project: Collection, Storage & Distribution of Water in Antiquity Linking Ancient Wisdom to Modern Needs*. 2009. http://www.hydriaproject.info/en/cases/athens/acropolis_hill/water_works.html

Jouanna, Jacques. "Water, Health, and Disease in the Hippocratic Treatise *Airs, Waters, Places*." Translated by Neil Allies. *Studies in Ancient Medicine: Greek Medicine from Hippocrates to Galen, Volume 40*. Edited by John Scarborough, Philip van der Eijk, Ann Ellis Hanson, and Joseph Ziegler. Netherlands: Brill, 2012.

Kirkpatrick, Aidan. "The Image of the City in Antiquity: Tracing the Origins of Urban Planning, Hippodamian Theory, and the Orthogonal Grid in Classical Greece." Canada: Unpublished dissertation at the University of Victoria, 2015.

Kopestonsky, Theodora. "The Greek Cult of the Nymphs at Corinth". *Hesperia*, vol. 85, no. 4, 2016: 711-777.

Kondis, I.D. "Ē diairesis tōn Thouriōn." In *Archaiologikē Ephēmeris* (1956). 106-113.

Krasilnikoff, Jens. "Irrigation as Innovation in Ancient Greek Agriculture." In *World Archaeology*, vol. 42, no. 1. USA: Taylor & Francis Group, 2010. 108-121.

Lewis, Michael. "Vitruvius and Greek Aqueducts." In *Papers of the British School at Rome,* vol. 67. Rome: British School at Rome, 1999. 145-172.

Linton, Jamie. *What is Water? The History of a Modern Abstraction*. Vancouver: UBC Press, 2009.

Lintott, Andrew. "Aristotle and Democracy." In *The Classical Quarterly*, vol. 42, no. 1. UK: Cambridge University Press on behalf of the Classical Association, 1992. 114-128.

Longo, Fausto. "From Sybaritic *Teichos* to Poseidonia. Reflections on the Origins and Early Decades in the Life of an Achaean *Apoikia*." In *Annvario della Scuola Archeologica di Atene e delle Missioni Italiane in Oriente*, supplement 3. Edited by Emanuele Greco and Athanasios Rizakis. Italy: Scuola Archaeologica Italiana di Atene, 2019.

Meagher, Sharon, Samantha Noll, and Joseph Biehl (eds.). *The Routledge Handbook of Philosophy of the City*. UK: Routeldge, 2020.
-- King, Loren. "Henri Lefebvre and the Right to the City." 76-86.
-- Klaver, Irene and J. Aaron Frith. "Returning Water to Urban Life: Governmentality of Green Infrastructure and the Emergence of New Human-Water Relations. 366-378.

Nova, Alessandro. "The Role of the Winds in Architectural Theory from Vitruvius to Scamozzi." In *Aeolian Winds and the Spirit in Renaissance Architecture*. Edited by Barbara Kendra. London: 2006. 70-86.

Neer, Richard T. and Leslie Kurke. "Pindar Fr. 75 SM and the Politics of Athenian Space." *Greek, Roman, and Byzantine Studies,* vol. 54, 2014: 527–579.

Osborne, Robin. "Did Democracy Transform Athenian Space?" *Building Communities: House, Settlement and Society in the Aegean and Beyond*, vol. 15, 2007: 195-199.

Owens, E.J. "The Enneakrounos Fountain-House." *The Journal of Hellenic Studies*, vol. 102, 1982: 222-225,

Owens, E.J. "The Kremna Aqueduct and Water Supply in Roman Cities." In *Greece & Rome*, vol. 38, no 1. UK: Cambridge University Press on behalf of the Classical Association, 1992. 41-58.

Paga, J. "The Claw-Tooth Chisel and the Hekatompedon Problem: Issues of Tool and Technique in Archaic Athens." *Athenische Mitteilungen* 127. Berlin: Gebr. Mann Verlag, 2015.

Paga, J. "The Southeast Fountain House in the Athenian Agora: A Reappraisal of Its Date and Historical Context." *Hesperia*, vol. 84, no. 2 (2015).

Papadopoulos, John. "The Original Kerameikos of Athens and the Siting of the Classical Agora." In *Greek, Roman, and Byzantine Studies*, vol. 37, is. 2. USA: Duke University Press, 1997. 107-130.

Pindar. *Odes*. From the Perseus Digital Library. Translated by Diane Arnson Svarlien, 1990. Online: Tufts University, updated 2019.

Plato. *Laws*. Translated with introduction by Trevor Saunders. England: Penguin Books Ltd., 1970.

Pope, Spencer. "Urbanization in inland Sicily: Acculturation on the periphery of the Greek world." In *Ancient Urban Planning in the Mediterranean: New Research Directions*. Edited by Samantha Martin-McAuliffe, Daniel Millette. USA: Routledge, 2018. 8-27.

Prieto, Alberto. *Landscape Organization in Magna Grecia*. Austin: University of Texas, 2005.

Race, William. "Pindar's 'Best is Water:' Best of What?". In *Greek, Roman, and Byzantine Studies*, vol. 22, is. 2. USA: Duke University Press, 1981.

Sandin, Pär. "The Emblems of Excellence in Pindar's First and Third Olympian Odes and Bacchylides' Third Epinician." In *Lexis: Poetica, Retorica e Comunicazione nella Tradizione Classica.* Edited by Adolf M. Hakkert. Venice: Vittorio Citti, 2014.

Shear Jr., T.L. "The Persian Destruction of Athens: Evidence from Agora Deposits", *Hesperia* 62 (1993).

Shipley, Graham. "Little Boxes on the Hillside: Greek Town Planning, Hippodamos, and Polis Ideology." In *The Imaginary Polis*. Edited by Mogans Herman Hansen. Copenhagen: The Royal Danish Academy of Science and Letters, 2005. 335-403.

Travlos, John. *A Pictorial Dictionary of Ancient Athens*. New York: Praeger Publishers, 1971.

Thompson, Homer. "Excavations in the Athenian Agora: 1953." In *Hesperia: the Journal of the American School of Classical Studies at Athens*, vol. 23, no. 1. Athens: The American School of Classical Studies at Athens, 1954. 31-67.

Thompson, Homer and R.E. Wycherley. *The Agora of Athens: the History, Shape, and Uses of an Ancient City Centre*. Athens: the American School of Classical Studies at Athens, 1972.

Thucydides. *History of the Peloponnesian War.* Translated by Rex Warner with introduction by M.I. Finley. England: Penguin Books Ltd., 1972.

Vasilodimitrakis-Hart, Seraphina. "ἄριστον μέν ὕδωρ: An Examination of the Public Waterworks in Athens in the Early 5thC BCE." In *Past Imperfect* vol. 23 (Canada: University of Alberta Press, 2021).

Vitruvius. *De Architectura*. Translated by Morris Hicky Morgan. Cambridge: Harvard University Press, 1914. Sourced from Perseus Tufts University Online Library.

Wickkiser, Bronwen L. *Asklepios, Medicine, and the Politics of Healing in Fifth-Century Greece: Between Craft and Cult.* Baltimore: The John Hopkins University Press, 2008.

Wikander, Örjan (ed.). *Handbook of Ancient Water Technology*. Leiden: Brill, 2000.

WSP. Australia: 2022. Accessed: August 20, 2022. https://www.wsp.com/en-TH/services/urban-planning-and-master-planning.

Wycherley, R.E. *The Athenian Agora III: Literary and Epigraphical Testimonia.* New Jersey: The American School of Classical Studies at Athens, 1957.

Wycherley, R.E. *How the Greeks Built Cities*. Toronto: MacMillan, 1962.

Yannopoulos, Stavros, Christos Yapijakis, Asimina Kaiafa-Sarapoulo, George Antoniou, and Andreas Angelakis. "Review Paper: History of Sanitation and Hygiene Technologies in the Hellenic World." *Journal of Water, Sanitation, and Higiene for Development*. London: IWA Publishing, 2017.